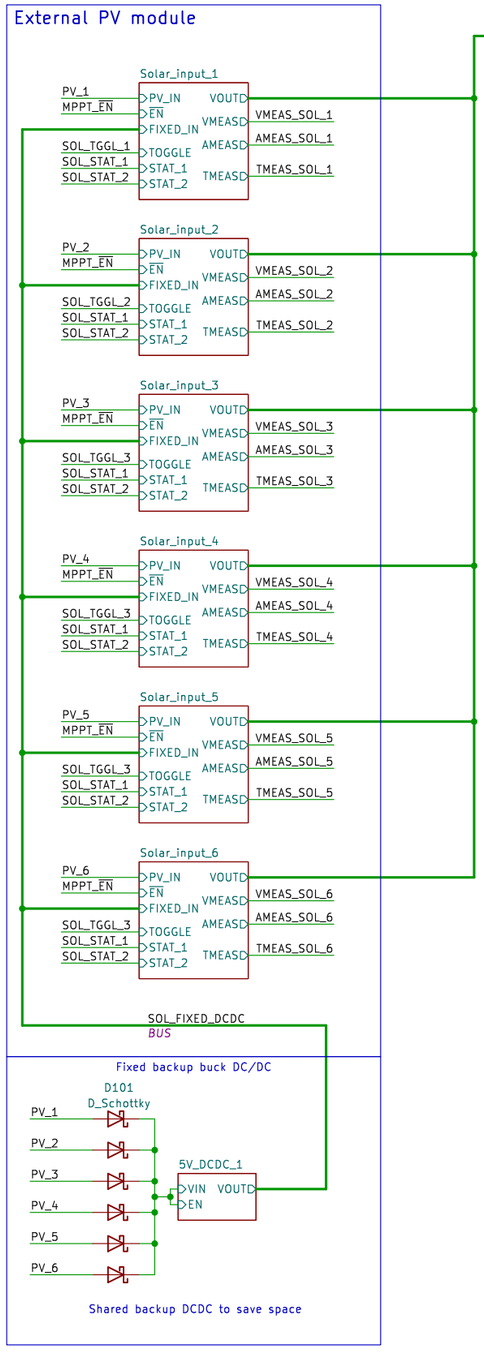
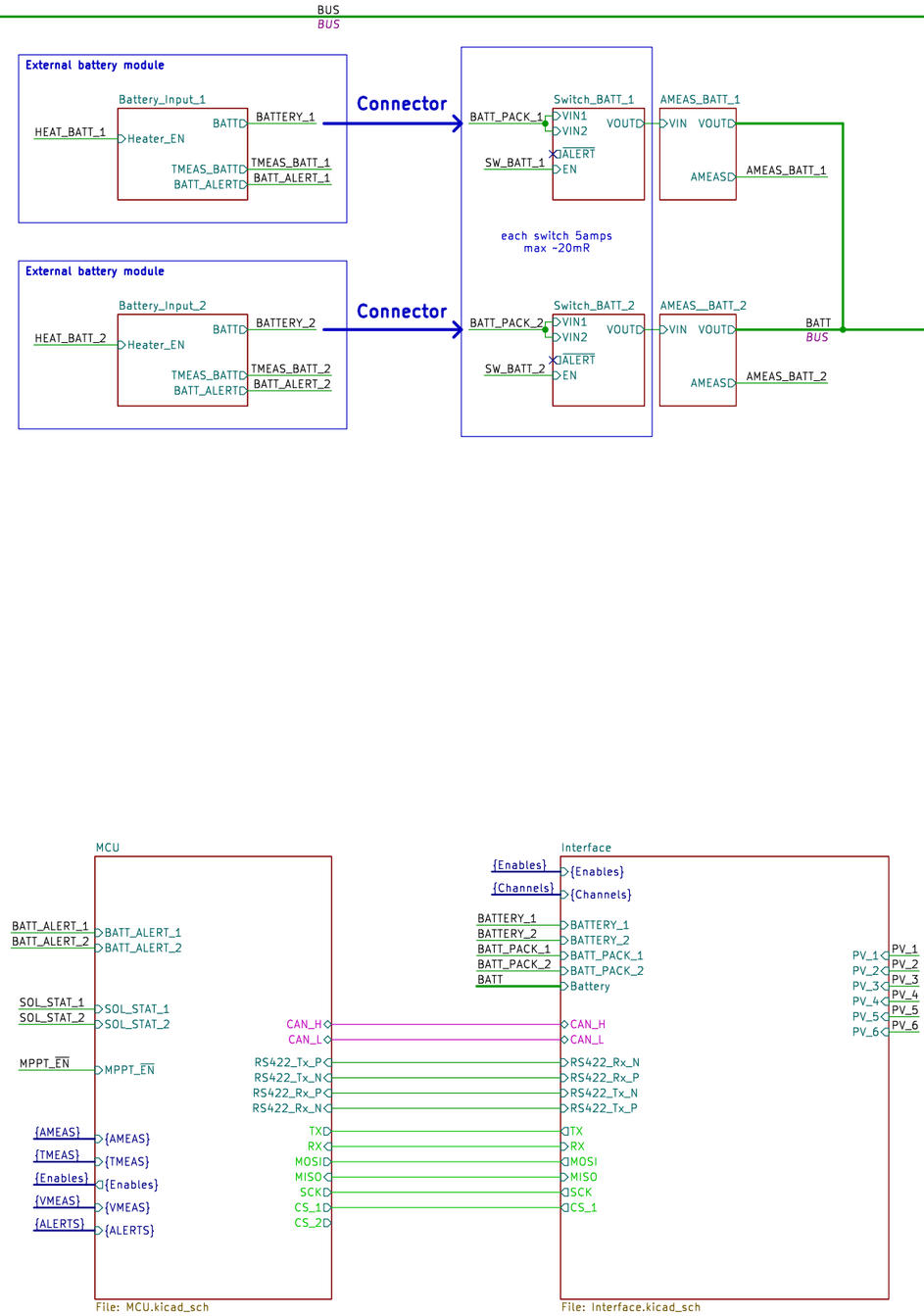
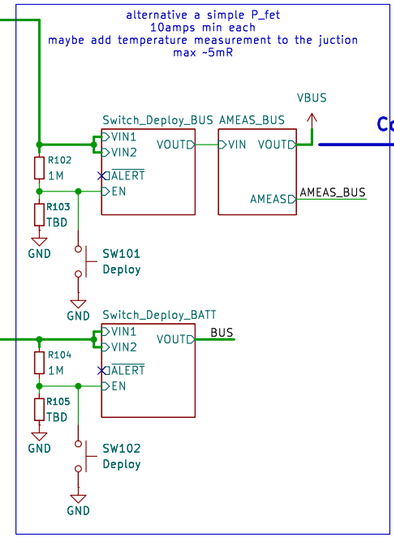
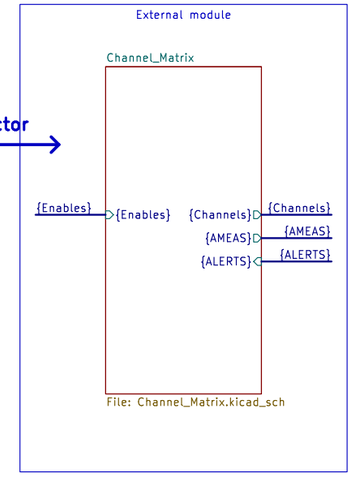
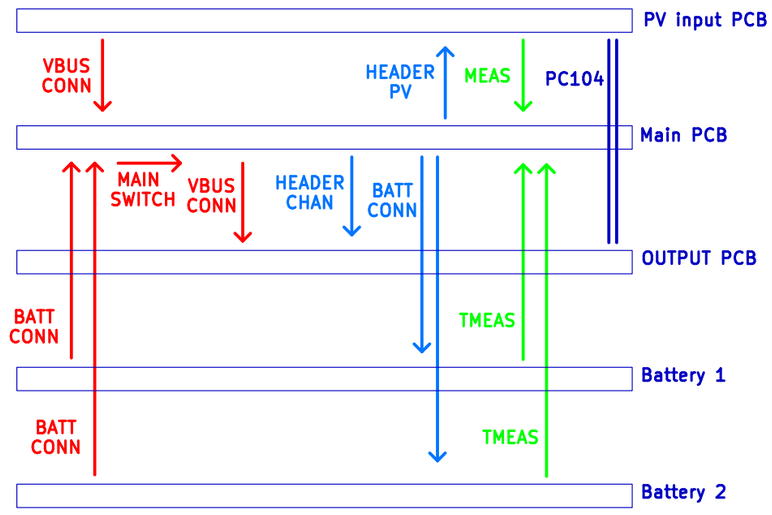
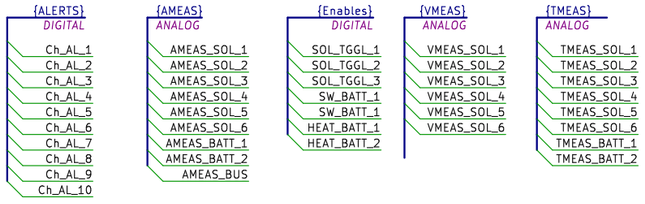


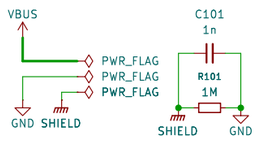


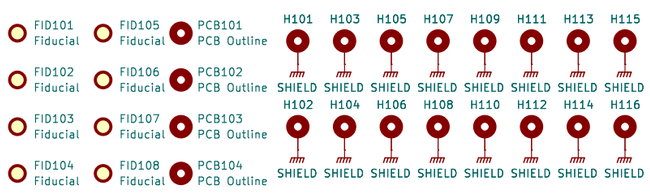












Sheet: /
File: EPS.kicad_sch

Title:

Size: A3	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 1/106

Inputs	Outputs
Solar Cell	Ouput voltage
	Measured voltage
	Measured current
	Temperature of the Cell

Input for solar cell with MPPT tracking
reverse current protection.
Temperature measurement

DC/DC controlled using PWM from CPU
to create MPPT function

solar 4S –> voltage > VBUS

MPPT Buck DC/DC

vyhoda Nastaveni pomoci odporu a ne ulozeni v registur

Charging current

$I_{CHARGE} = \frac{40\ mV}{R_{SR}}$

$I_{PRECHARGE} = \frac{4\ mV}{R_{SR}}$

PV, TP201, D202 D_Schottky, R205 10, C205 1u, C201 1u, C203 1u (REGN), U201 BQ24650, R201 500k

Termistor for monitoring should be bypassed with EN signal from MCU
TP202 Term, R203 40k, R204 60k
V term set to 60% –> charging is always ON

VREF, TERM_EN, MPPSET, VCC, HIDRV, PH, BTST, REGN, LODRV, SRP, SRN, VFB, TS, STAT1, STAT2, GND

Q202 NMOS, Q203 NMOS, C204 1u, D201 D_Schottky, C202 1u

L201 TBD, RSR201 20m, C206 1u, C208 1u

R206 100k, R207 100k, +5V+5V, STAT_1, STAT_2

TP204, C207 1u, R208 500k, R209 67k

$V_{BAT} = 2.1\ V \times \left[1 + \frac{R2}{R1}\right]$

where
- R2 is connected from VFB to the battery
- and R1 is connected from VFB to GND.

Output battery voltage adj 2.1V on VFB

TP203, Disable Charging, EN, CE, Q201 NMOS, R202 36k

MPPTSET is regulated at 1.2V

$V_{MPPSET} = 1.2\ V \times \left[1 + \frac{R3}{R4}\right]$

Switch_SOL_1: VIN1, VIN2, VOUT, ALERT, EN; R210 100k, R211 1k

Toggles between fixed and MPPT
Default: fixed
TOGGLED, TP205

Switch_SOL_2: VIN1, VIN2, VOUT, ALERT, EN; FIXED_IN; R214 100k, R212 10, R215 1k, R213 100k, Q204 NMOS

AMEAS_1: PV_IN, VIN, VOUT, PV, AMEASD, AMEAS

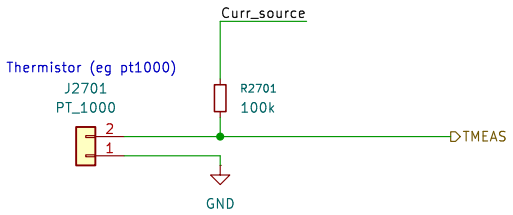
PV, R216 1M, VMEAS, R217 1M, GND

Temp_sens_solar_cell: TMEASD, TMEAS
File: Temp_sens.kicad_sch

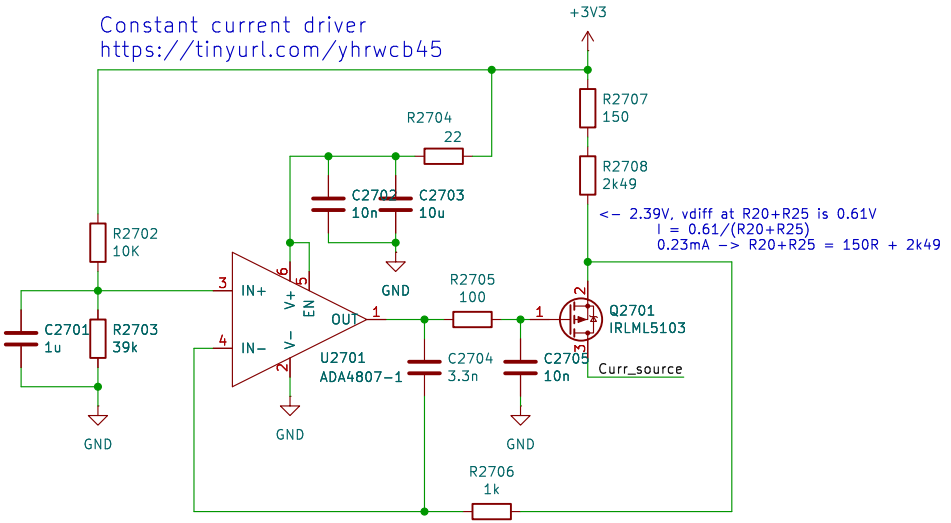
Sheet: /Solar_input_1/
File: Solar_Cell_Input.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 2/106



From spacetemp



Sheet: /Solar_input_1/Temp_sens_solar_cell/
File: Temp_sens.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 29/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

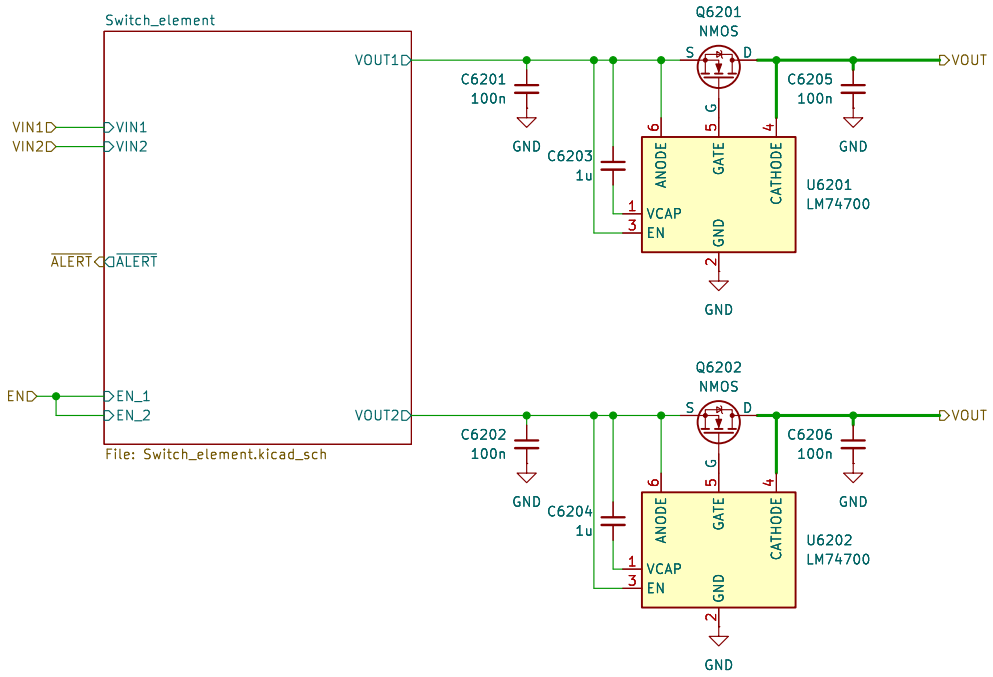
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_1/Switch_SOL_1/
File: Switch_H.kicad_sch

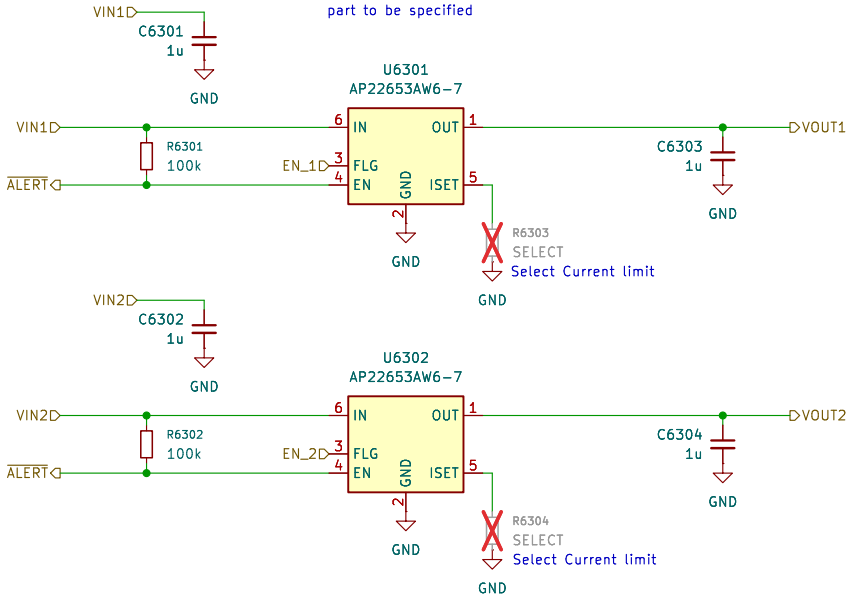
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 64/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Solar_input_1/Switch_SOL_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 65/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

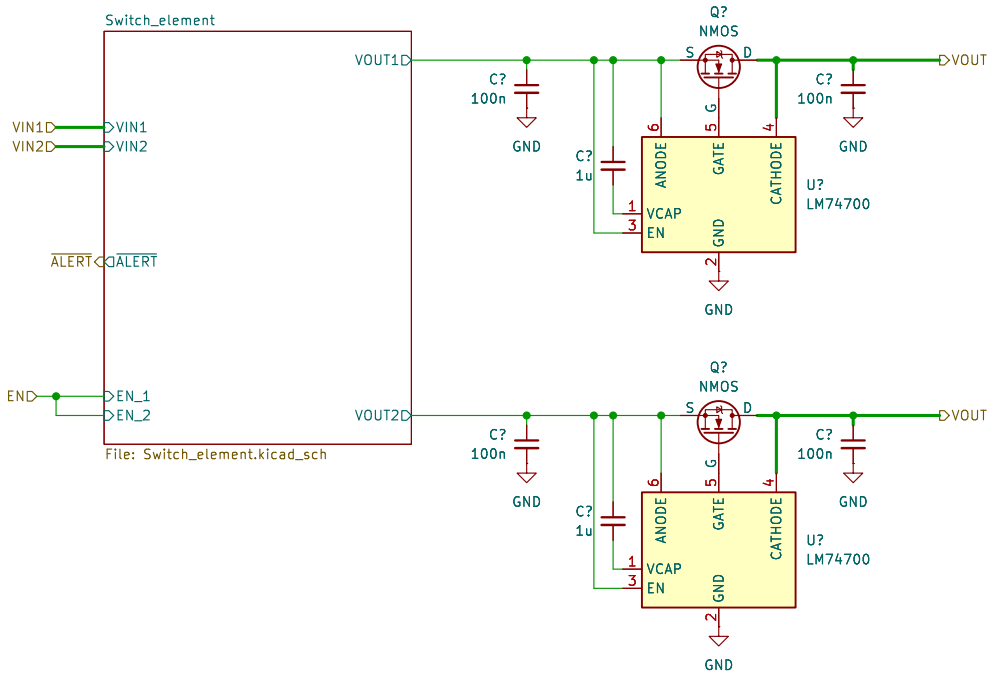
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_1/Switch_SOL_2/
File: Switch_H.kicad_sch

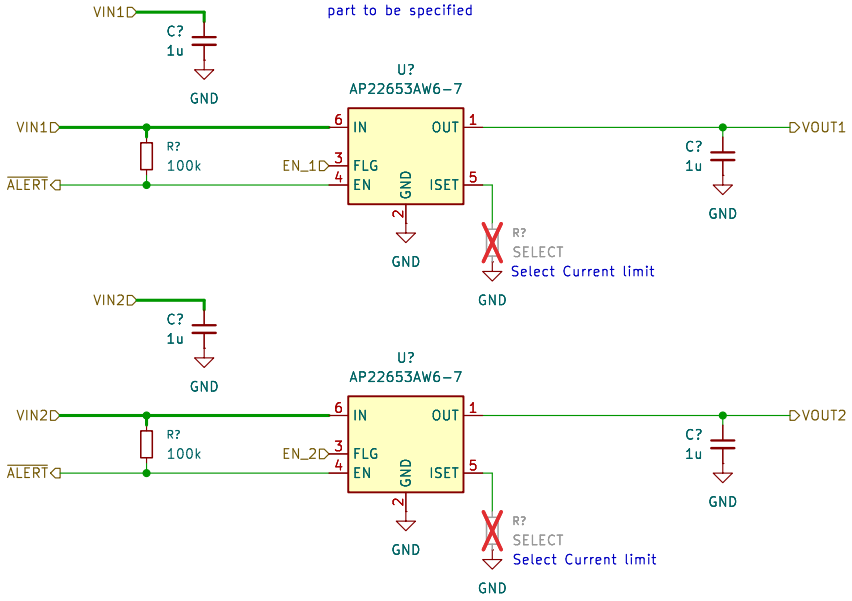
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 70/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

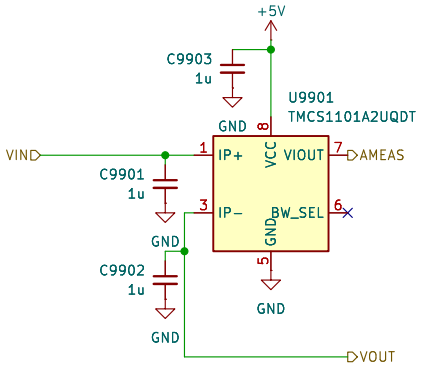
20A
TPS1685
TPS25983
LTC4226



Sheet: /Solar_input_1/Switch_SOL_2/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 99/106



Sheet: /Solar_input_1/AMEAS_1/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 105/106

Inputs	Outputs
Solar Cell	Ouput voltage
	Measured voltage
	Measured current
	Temperature of the Cell

Input for solar cell with MPPT tracking
reverse current protection.
Temperature measurement

DC/DC controlled using PWM from CPU
to create MPPT function

solar 4S -> voltage > VBUS

MPPT Buck DC/DC

vyhoda Nastaveni
pomoci odporu a ne
ulozeni v registur

PV
TP301
D302
D_Schottky
R305
10
C301
1u
GND
U301
BQ24650
REGN
C303
1u
GND
C305
1u
GND
R301
500k
VCC
HIDRV
PH
BTST
REGN
LODRV
SRP
SRN
VFB
TS
STAT1
STAT2
GND
VREF
TERM_EN
MPPSET
Q302
NMOS
Q303
NMOS
C304
1u
L301
TBD
R308
20m
C306
1u
GND
C308
1u
GND
D301
D_Schottky
C302
1u
GND
Charging current
$I_{CHARGE} = \frac{40\ mV}{R_{SR}}$
$I_{PRECHARGE} = \frac{4\ mV}{R_{SR}}$

Termistor for monitoring
should be bypassed
with EN signal from MCU
TP302
Term
R303
40k
R304
60k
GND
V term set to 60% ->
charging is always ON

TP303
Disable
Charging
EN
CE
Q301
NMOS
R302
36k
GND
GND

MPPTSET is regulated at 1.2V

$V_{MPPSET} = 1.2\ V \times \left[1 + \frac{R3}{R4}\right]$

+5V+5V
R306
100k
R307
100k
STAT_1
STAT_2
TP304
C307
1u
R309
500k
R310
67k
GND
$V_{BAT} = 2.1\ V \times \left[1 + \frac{R2}{R1}\right]$
where
- R2 is connected from VFB to the battery
- and R1 is connected from VFB to GND.

Output battery
voltage adj
2.1V on VFB

Toggles between fixed and MPPT
Default: fixed
TOGGLED
TP305

Switch_SOL_1
VIN1
VIN2
VOUT
ALERT
EN
R311
100k
R312
1k

Switch_SOL_2
FIXED_IN
R315
100k
R313
10
R316
1k
R314
100k
NMOS
Q304
GND

AMEAS_1
PV_IN
VIN
VOUT
PV
AMEASD
AMEAS

PV
R317
1M
VMEAS
R318
1M
GND

Temp_sens_solar_cell
TMEASD
TMEAS
File: Temp_sens.kicad_sch

Sheet: /Solar_input_2/
File: Solar_Cell_Input.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 3/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

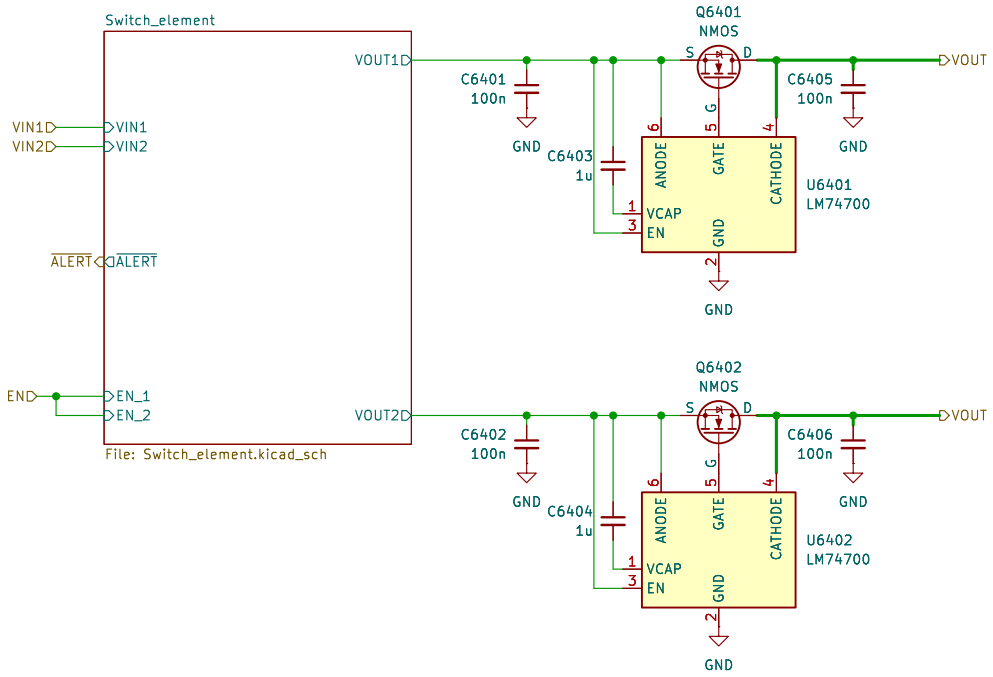
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_2/Switch_SOL_1/
File: Switch_H.kicad_sch

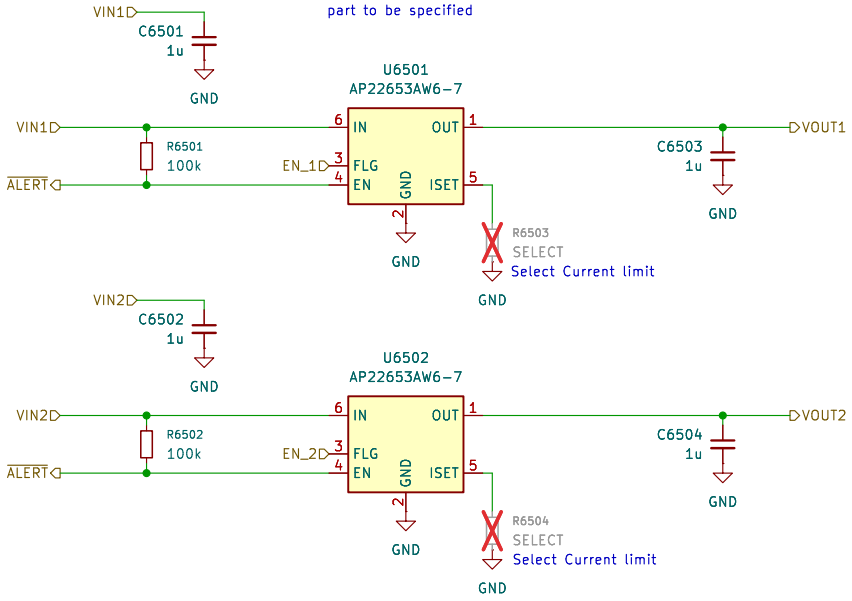
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 66/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Solar_input_2/Switch_SOL_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 67/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

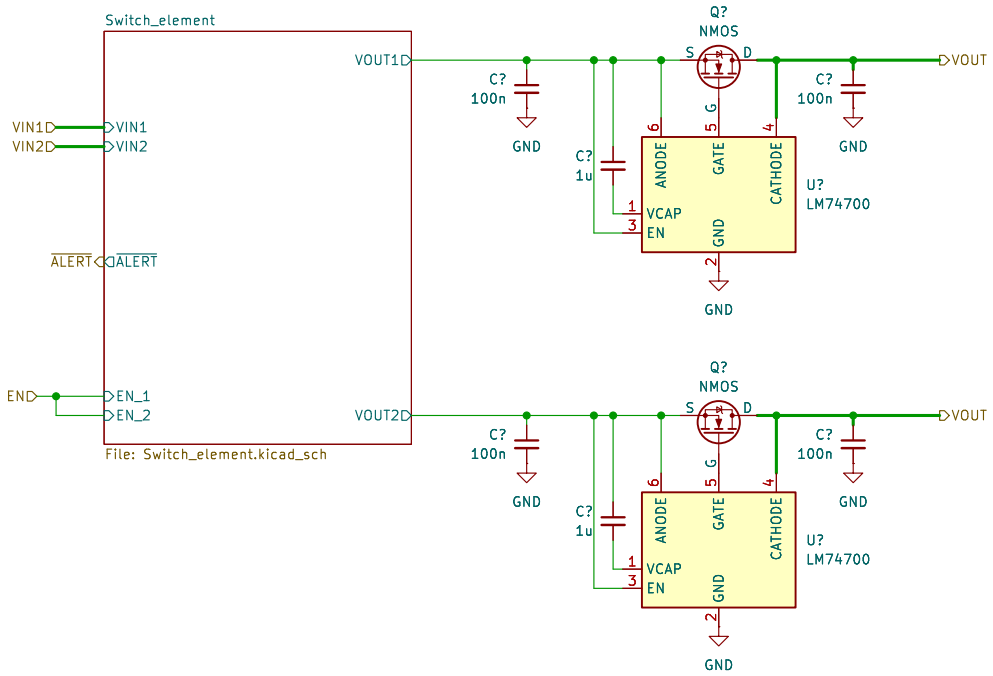
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_2/Switch_SOL_2/
File: Switch_H.kicad_sch

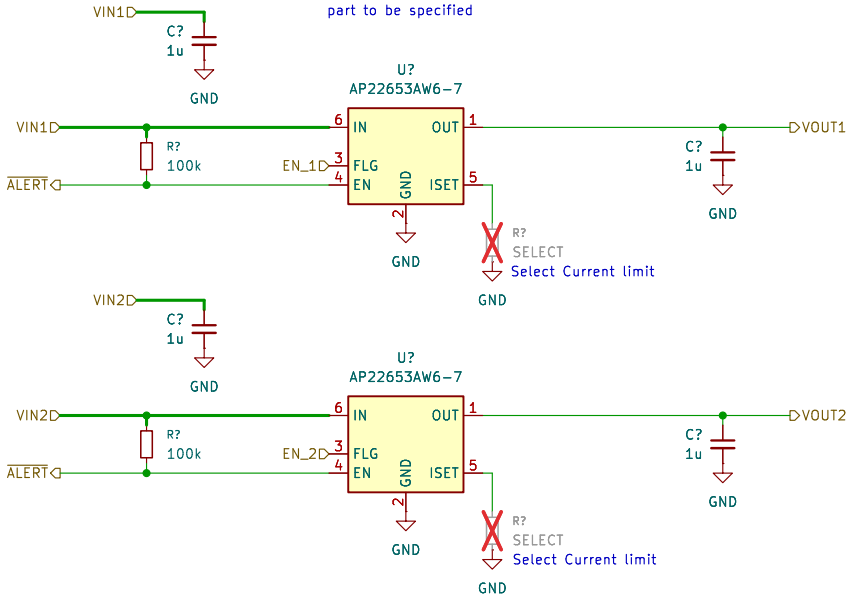
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 72/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

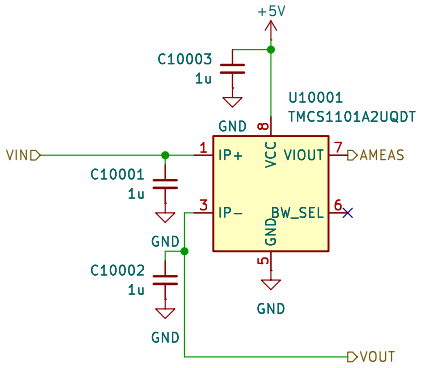
20A
TPS1685
TPS25983
LTC4226



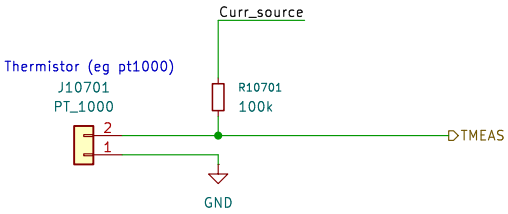
Sheet: /Solar_input_2/Switch_SOL_2/Switch_element/
File: Switch_element.kicad_sch

Title:

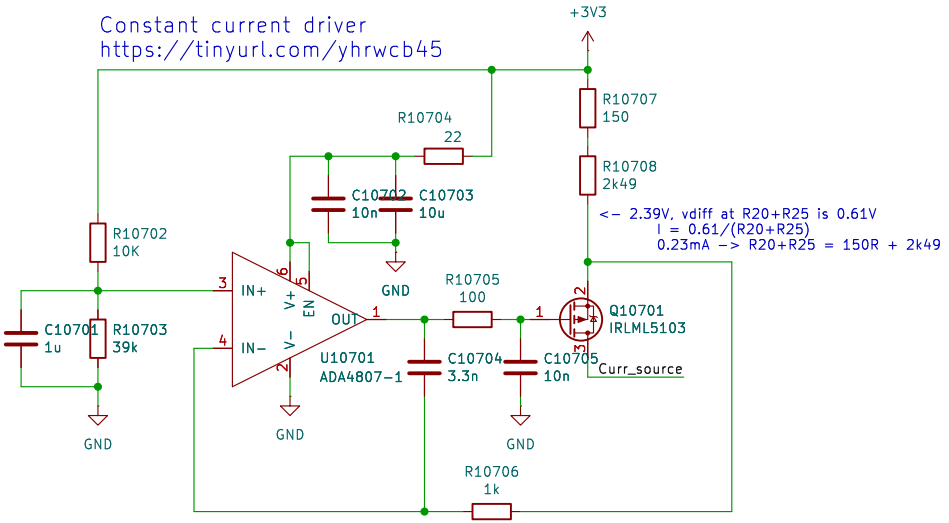
Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 101/106



Sheet: /Solar_input_2/AMEAS_1/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 106/106



From spacetemp



Sheet: /Solar_input_2/Temp_sens_solar_cell/		
File: Temp_sens.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 100/106

Inputs	Outputs
Solar Cell	Ouput voltage
	Measured voltage
	Measured current
	Temperature of the Cell

Input for solar cell with MPPT tracking
reverse current protection.
Temperature measurement

DC/DC controlled using PWM from CPU
to create MPPT function

solar 4S -> voltage > VBUS

MPPT Buck DC/DC

vyhoda Nastaveni
pomoci odporu a ne
ulozeni v registur

Charging current

$I_{CHARGE} = \frac{40\ mV}{R_{SR}}$

$I_{PRECHARGE} = \frac{4\ mV}{R_{SR}}$

PV, TP401, D402 D_Schottky, R405 10, C405 1u, GND

U401 BQ24650

VCC, HIDRV, PH, BTST, REGN, LODRV, VREF, TERM_EN, MPPSET, SRP, SRN, VFB, TS, STAT1, STAT2, GND

REGN: C403 1u, GND; D401 D_Schottky; C401 1u, GND; C404 1u

Q402 NMOS, Q403 NMOS

L401 TBD, R408 20m

C406 1u, GND; C408 1u, GND

R401 500k

Termistor for monitoring
should be bypassed
with EN signal from MCU

R403 40k, TP402, Term, R404 60k, GND

V term set to 60% ->
charging is always ON

TP403

Disable
Charging
EN, CE, G, Q401 NMOS, S, D, GND

R402 36k, GND

MPPTSET is regulated at 1.2V

$V_{MPPSET} = 1.2\ V \times \left[1 + \frac{R3}{R4}\right]$

+5V+5V, R406 100k, R407 100k, STAT_1, STAT_2

TP404, C407 1u, R409 500k, R410 67k, GND

$V_{BAT} = 2.1\ V \times \left[1 + \frac{R2}{R1}\right]$

where
- R2 is connected from VFB to the battery
- and R1 is connected from VFB to GND.

Output battery
voltage adj
2.1V on VFB

Switch_SOL_1: VIN1, VIN2, VOUT, ALERT, EN; R411 100k, R412 1k

Toggles between fixed and MPPT
Default: fixed

TOGGLED, TP405

Switch_SOL_2: VIN1, VIN2, VOUT, ALERT, EN; FIXED_IN; R415 100k, R413 10, R416 1k, R414 100k, Q404 NMOS, GND

AMEAS_1: PV_IN, VIN, VOUT, PV, AMEASD, AMEAS

PV, R417 1M, VMEAS, R418 1M, GND

Temp_sens_solar_cell: TMEASD, TMEAS

File: Temp_sens.kicad_sch

Sheet: /Solar_input_3/
File: Solar_Cell_Input.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 4/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

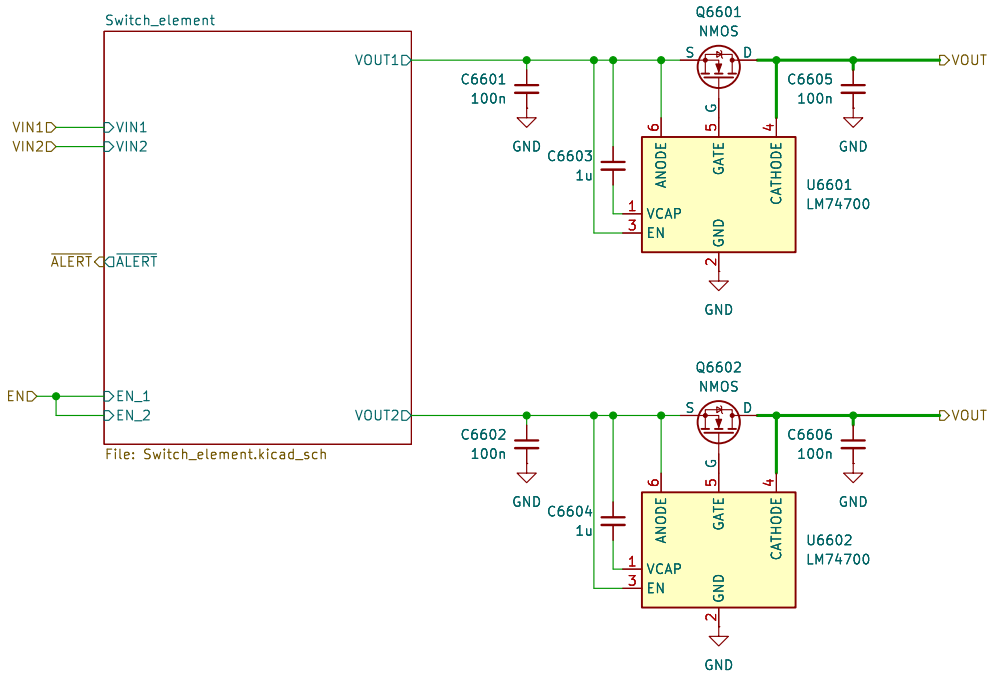
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_3/Switch_SOL_1/
File: Switch_H.kicad_sch

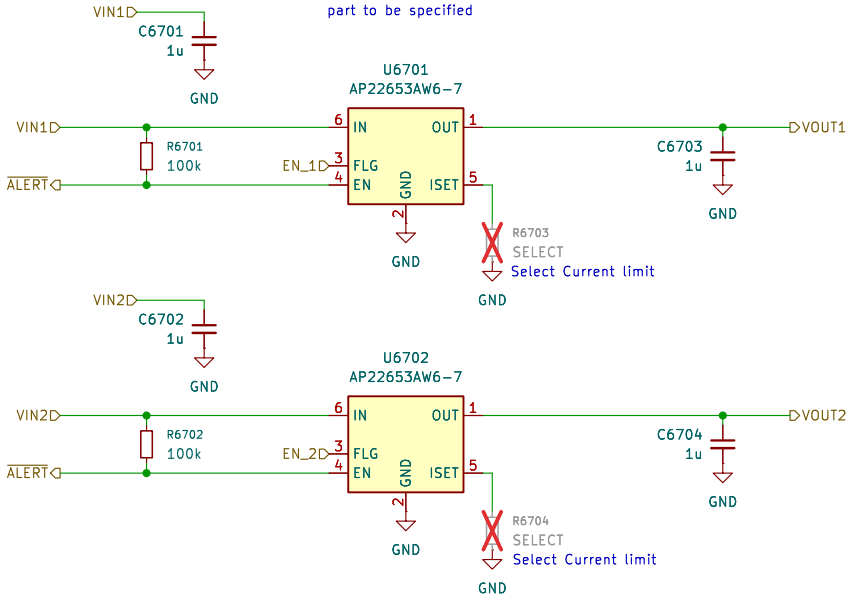
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 68/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Solar_input_3/Switch_SOL_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 69/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

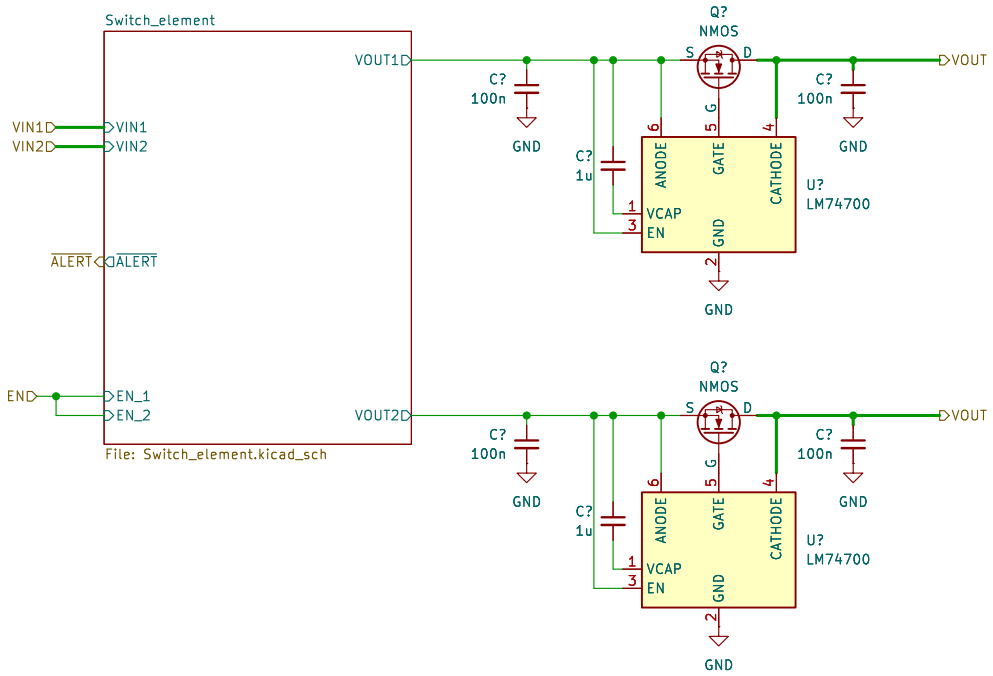
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_3/Switch_SOL_2/
File: Switch_H.kicad_sch

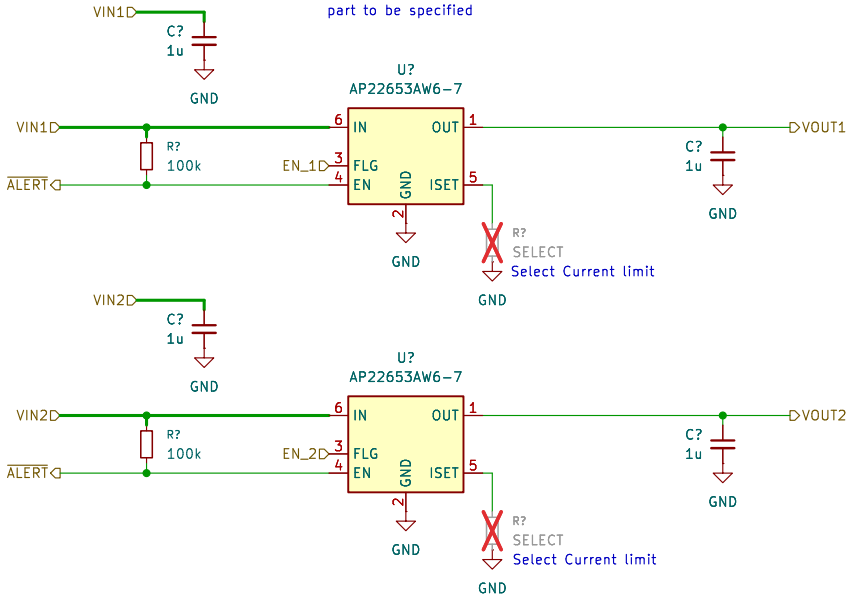
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 74/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

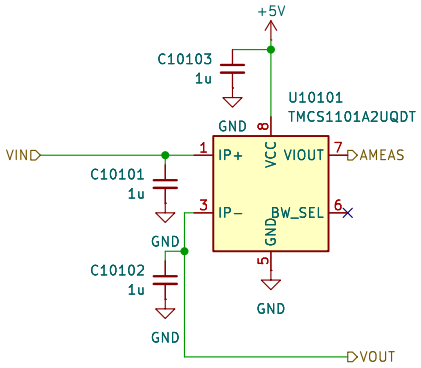
20A
TPS1685
TPS25983
LTC4226



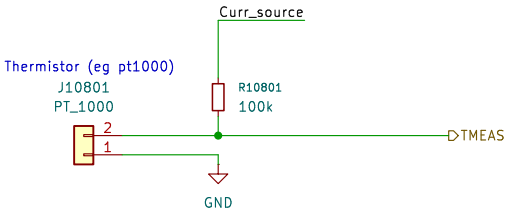
Sheet: /Solar_input_3/Switch_SOL_2/Switch_element/
File: Switch_element.kicad_sch

Title:

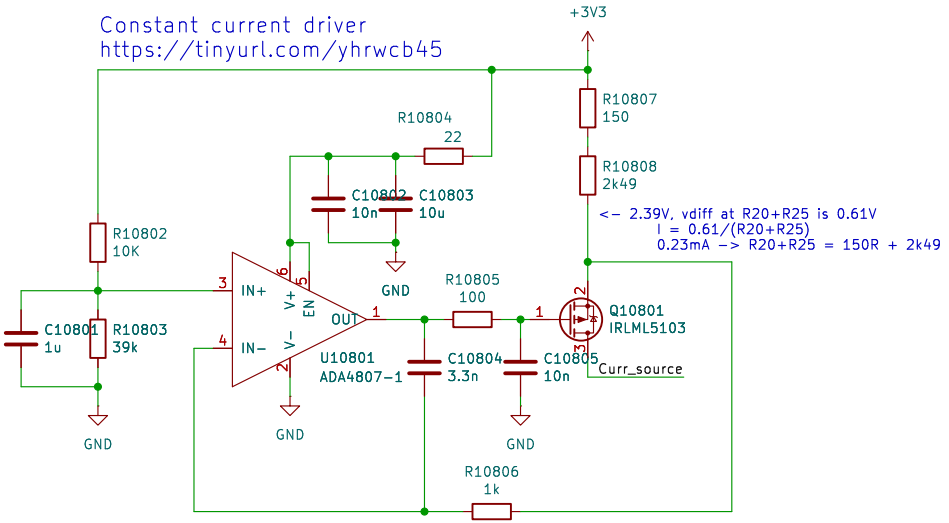
Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 103/106



Sheet: /Solar_input_3/AMEAS_1/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 107/106



From spacetemp



Sheet: /Solar_input_3/Temp_sens_solar_cell/
File: Temp_sens.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 102/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

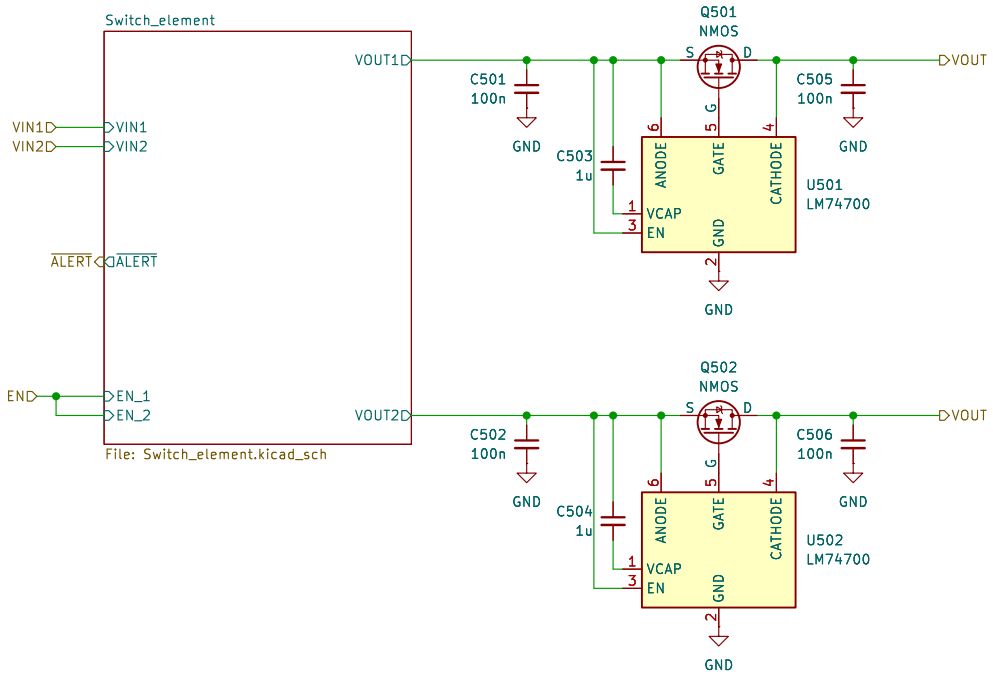
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Switch_BATT_1/
File: Switch_H.kicad_sch

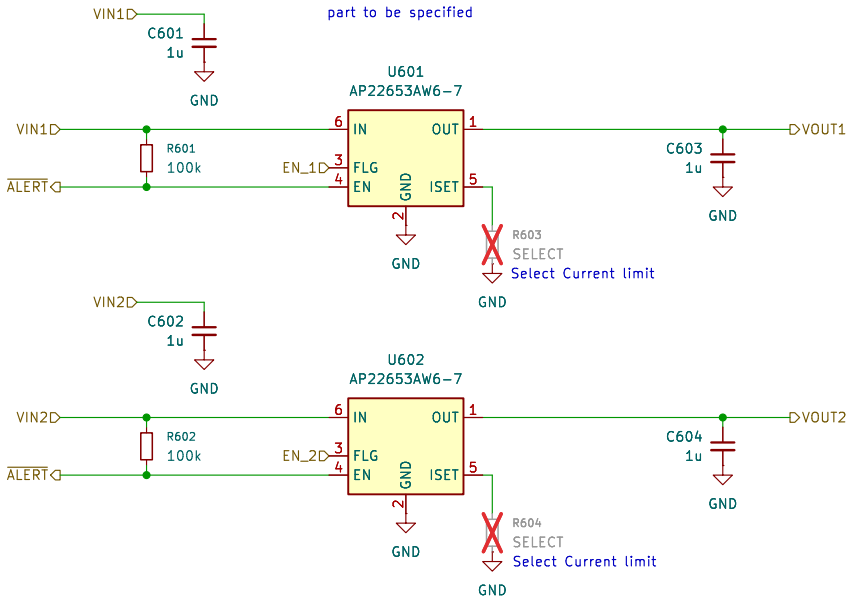
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 5/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Switch_BATT_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 6/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

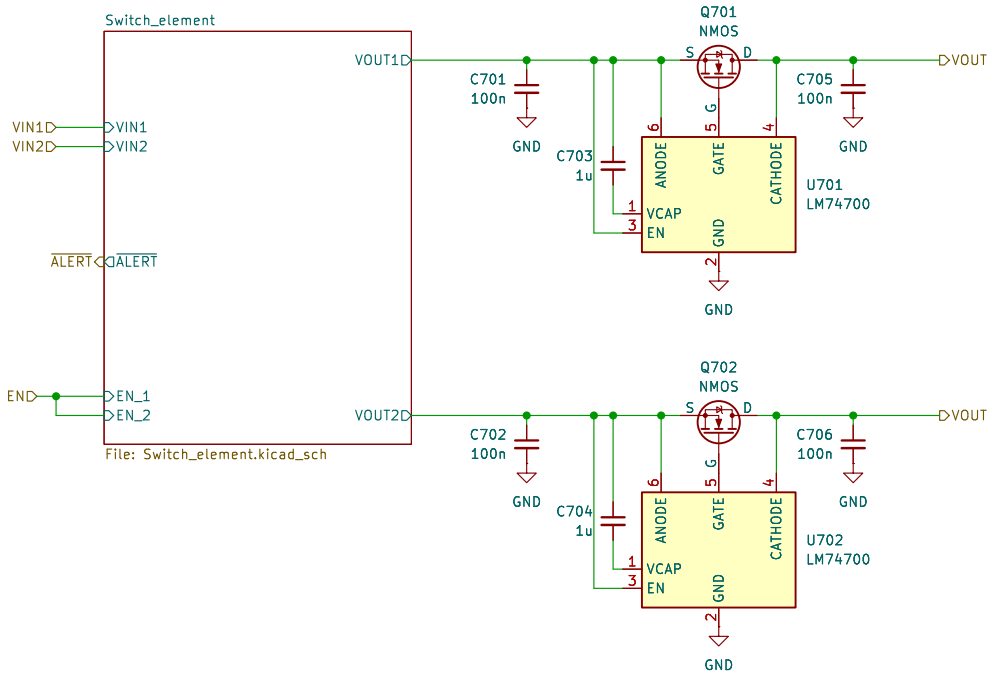
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Switch_BATT_2/
File: Switch_H.kicad_sch

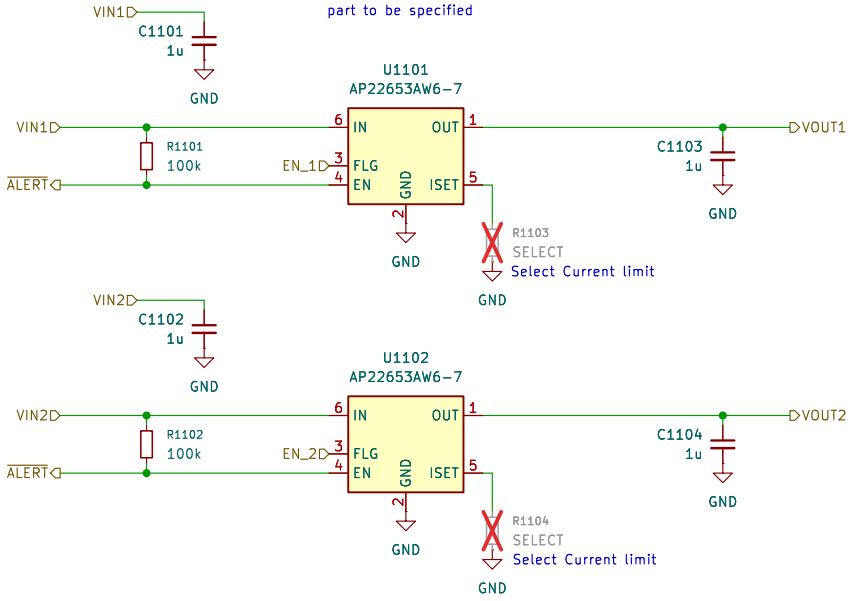
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 7/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Switch_BATT_2/Switch_element/
File: Switch_element.kicad_sch

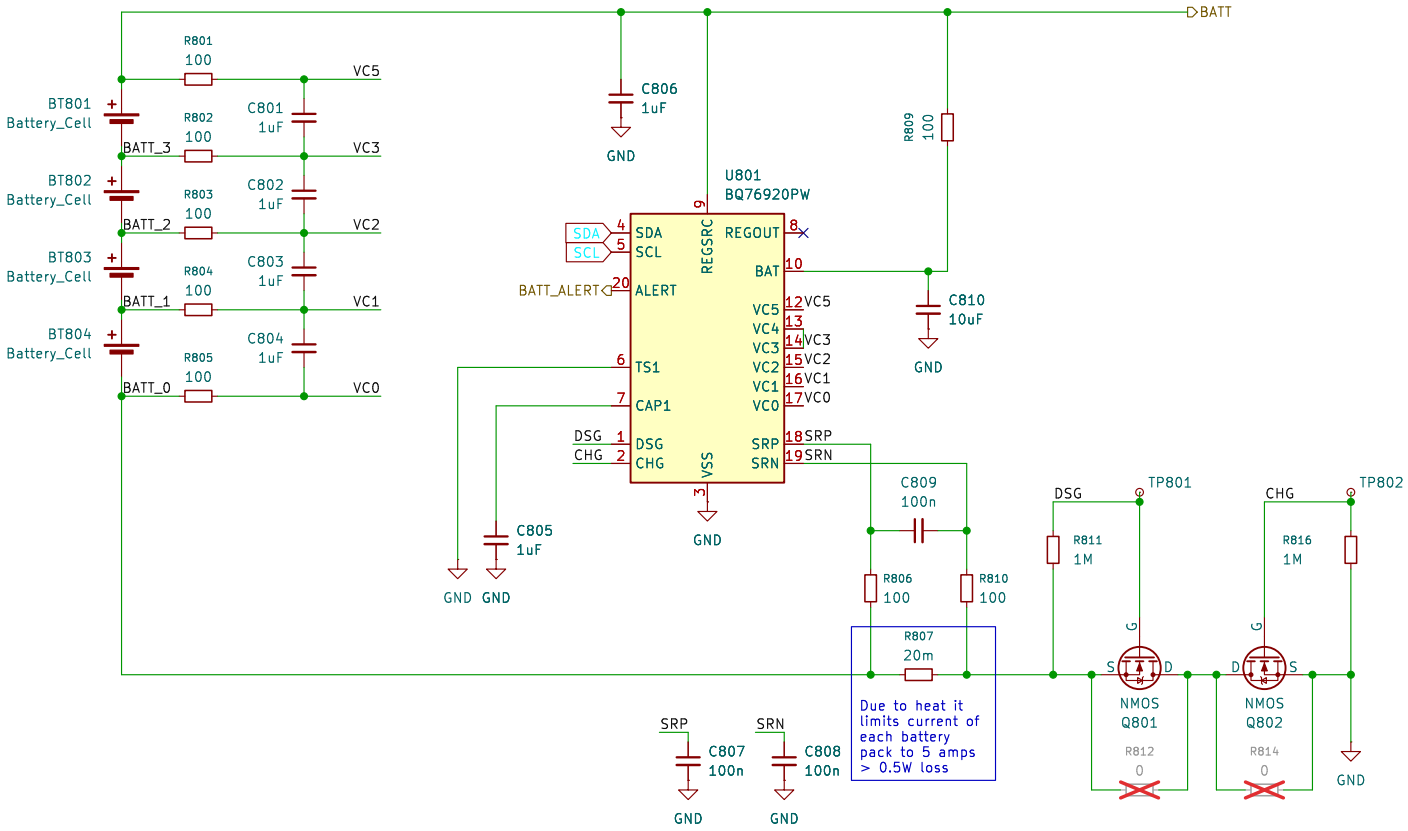
Title:

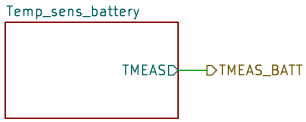
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 11/106

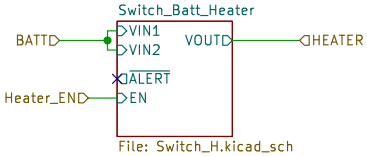
Inputs	Outputs
Input voltage	Ouput voltage
Heater Enable	Measured voltage
4S battery	Measured current
	Temperature of the Cell
	Temperature of the charger (not sure)

Input for Battery cell with balancing circuit
Temperature measurement of the battery
Heater for maintaininig battery temperature

Power that charges the batteries is regulated by MPPT in SOL



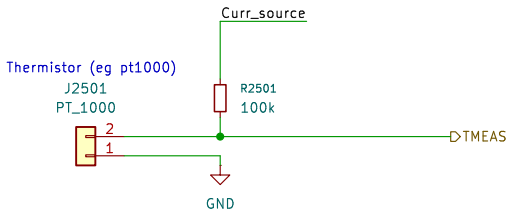




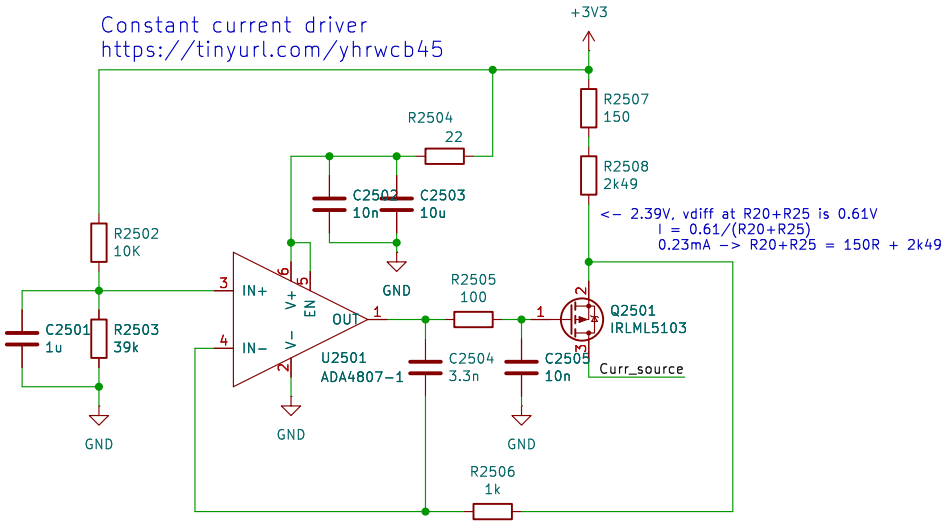
Sheet: /Battery_Input_1/
File: Battery_Cell_Input.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 8/106



From spacetemp



Sheet: /Battery_Input_1/Temp_sens_battery/		
File: Temp_sens.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 27/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

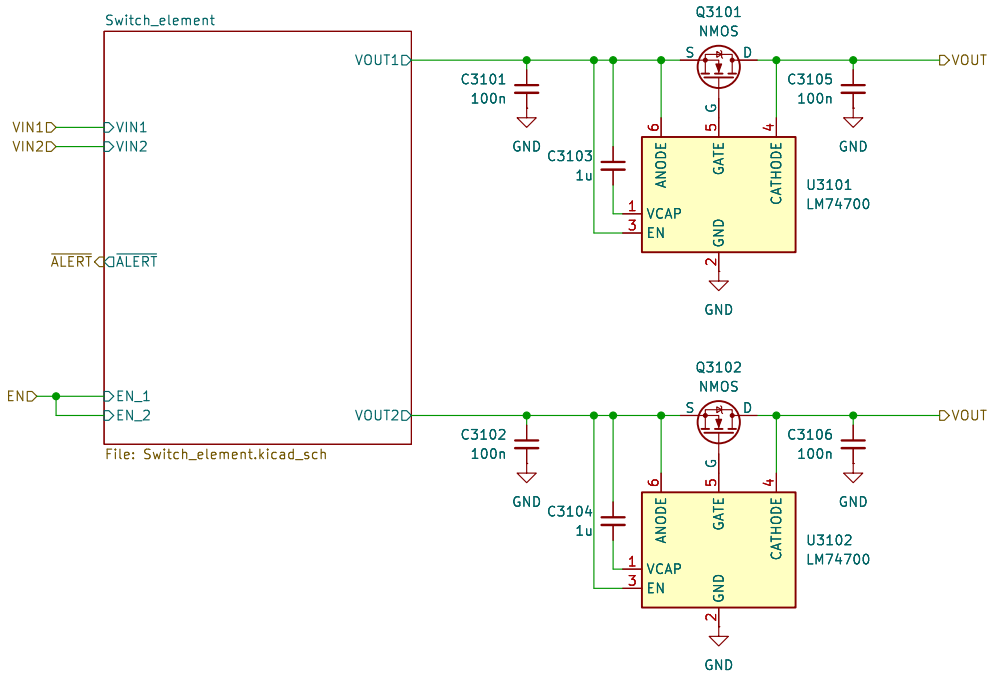
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Battery_Input_1/Switch_Batt_Heater/
File: Switch_H.kicad_sch

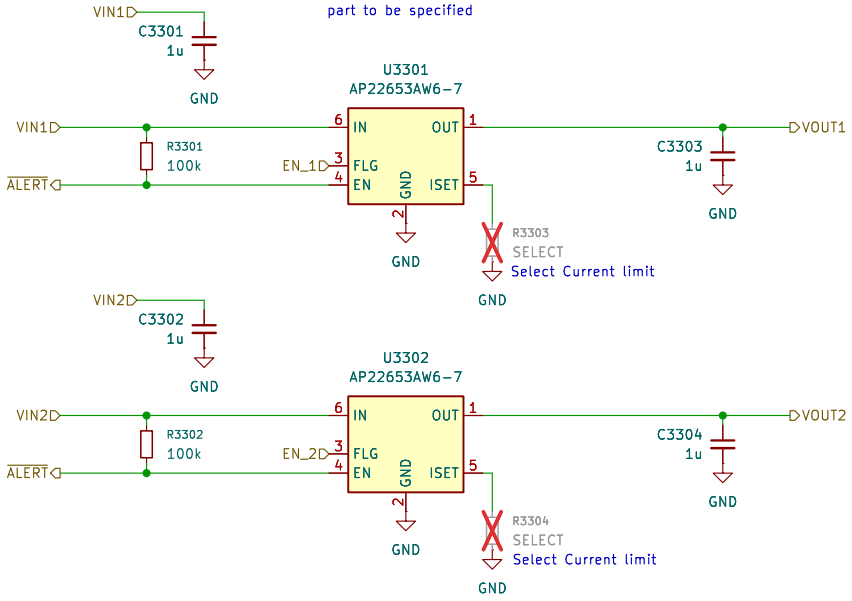
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 33/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Battery_Input_1/Switch_Batt_Heater/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 35/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

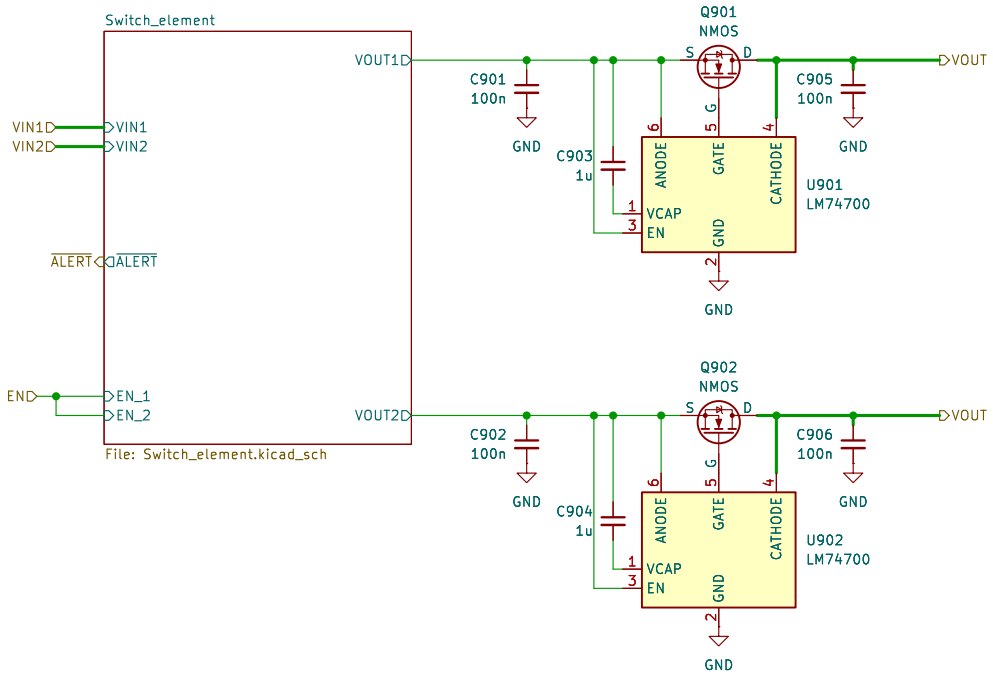
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Switch_Deploy_BATT/
File: Switch_H.kicad_sch

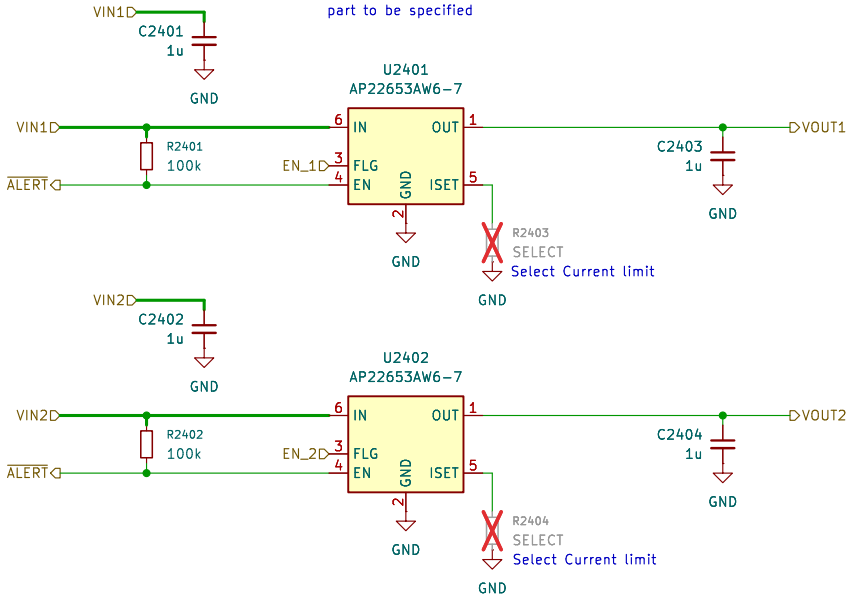
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 9/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Switch_Deploy_BATT/Switch_element/
File: Switch_element.kicad_sch

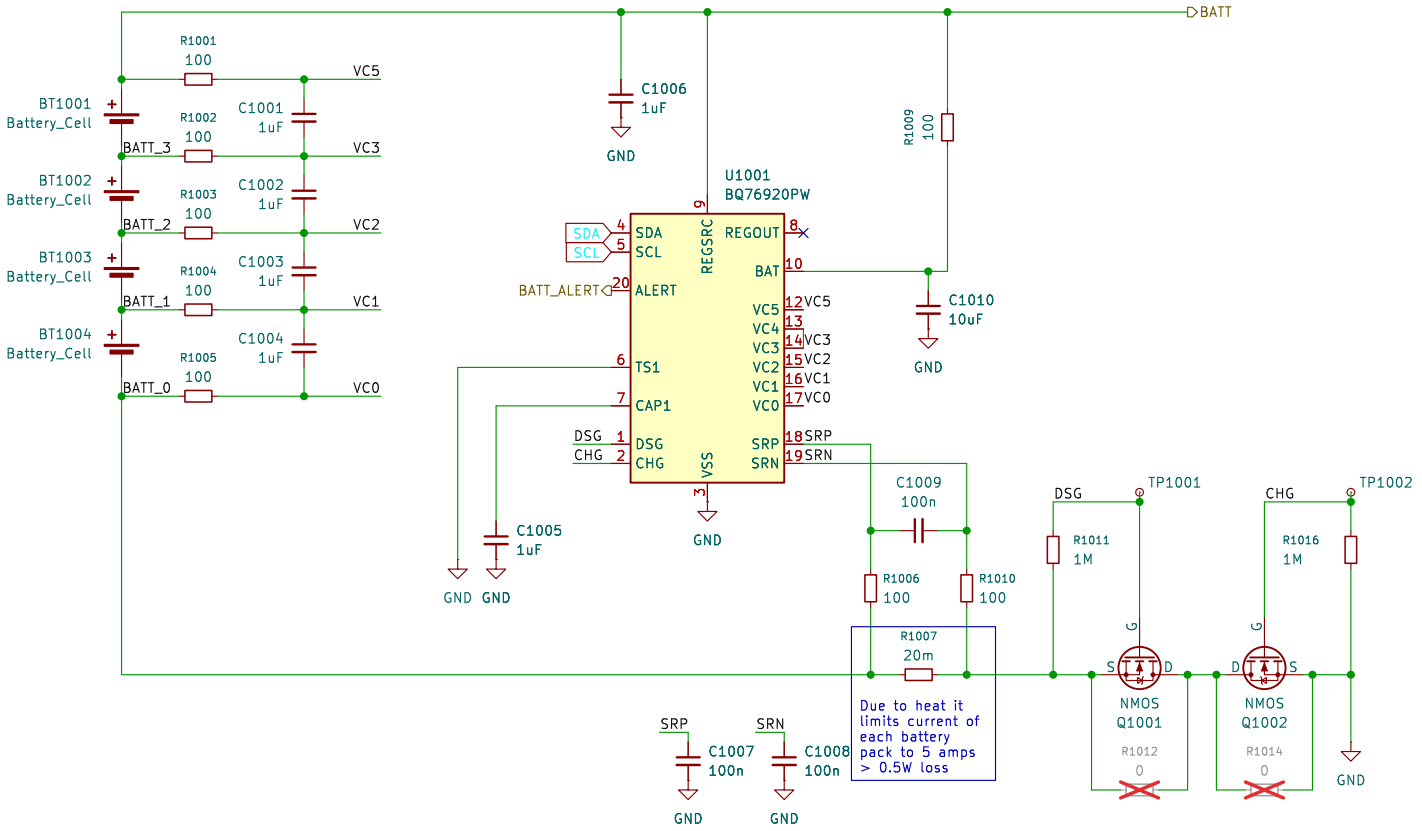
Title:

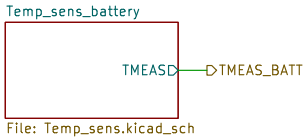
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 26/106

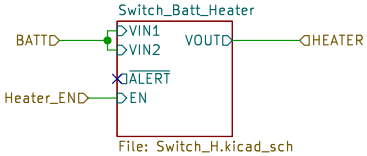
Inputs	Outputs
Input voltage	Ouput voltage
Heater Enable	Measured voltage
4S battery	Measured current
	Temperature of the Cell
	Temperature of the charger (not sure)

Input for Battery cell with balancing circuit
Temperature measurement of the battery
Heater for maintaininig battery temperature

Power that charges the batteries is regulated by MPPT in SOL



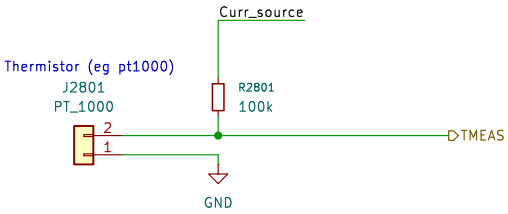




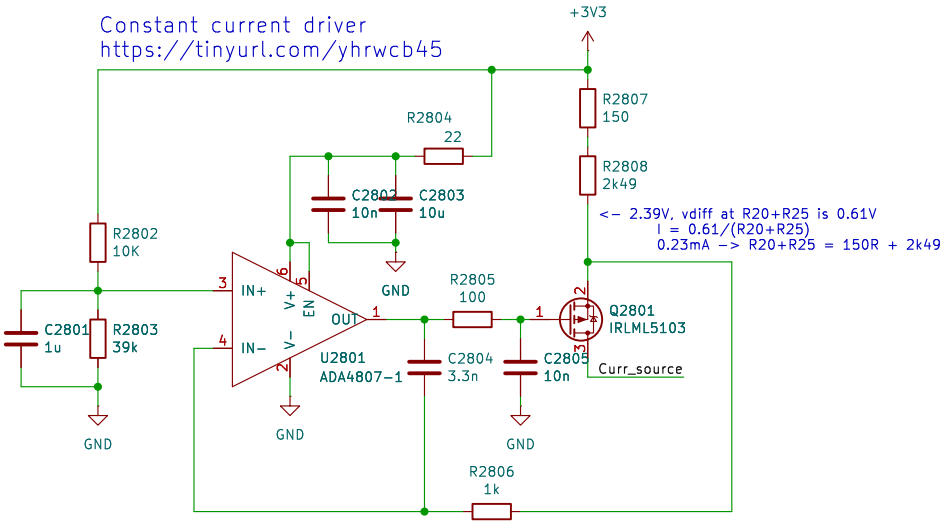
Sheet: /Battery_Input_2/
File: Battery_Cell_Input.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 10/106



From spacetemp



Sheet: /Battery_Input_2/Temp_sens_battery/
File: Temp_sens.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 30/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

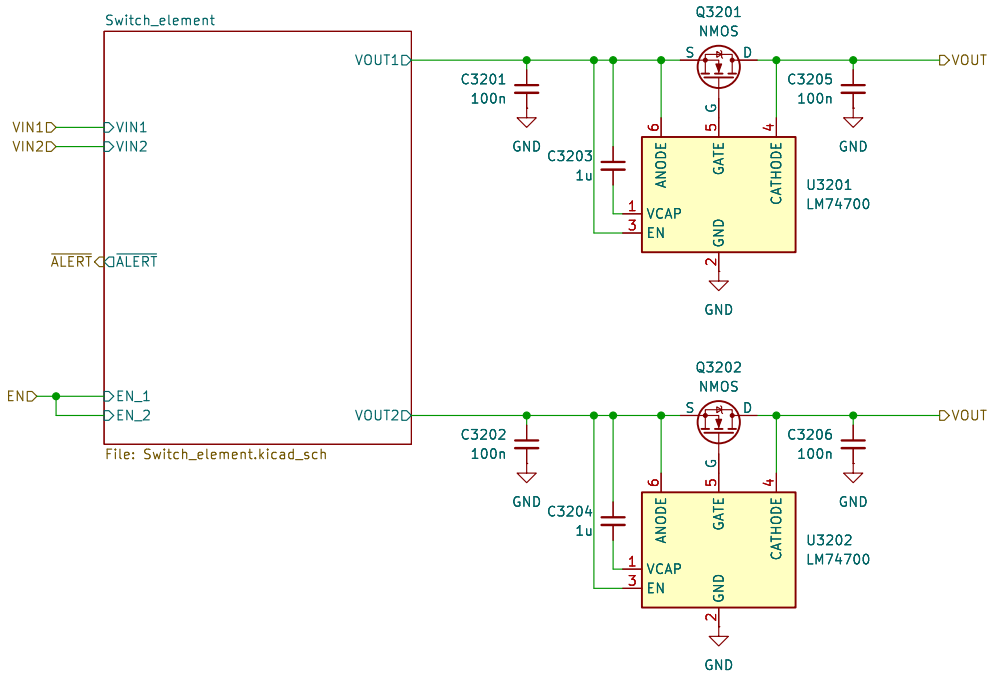
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Battery_Input_2/Switch_Batt_Heater/
File: Switch_H.kicad_sch

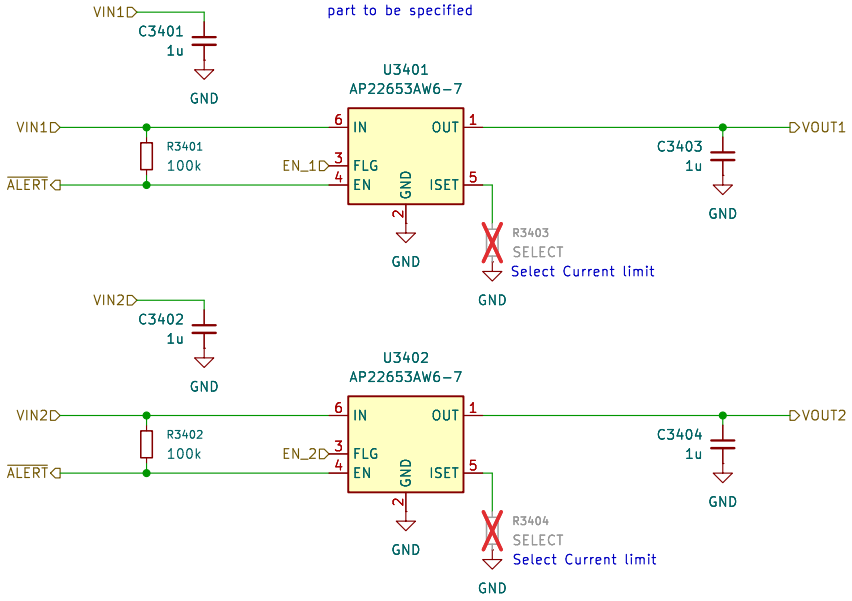
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 34/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Battery_Input_2/Switch_Batt_Heater/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 36/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

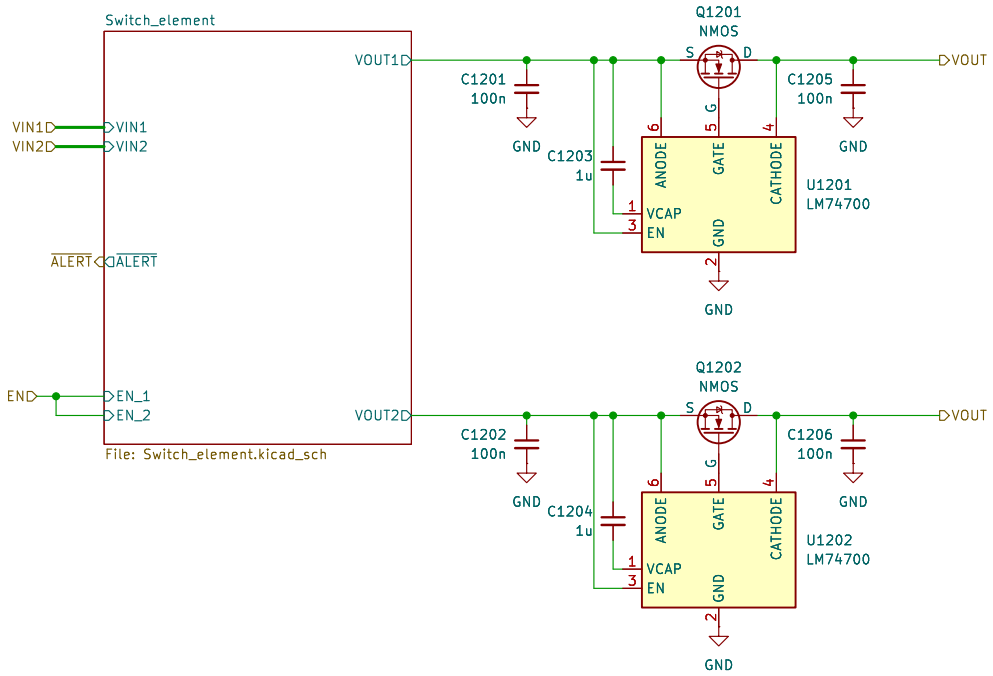
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Switch_Deploy_BUS/
File: Switch_H.kicad_sch

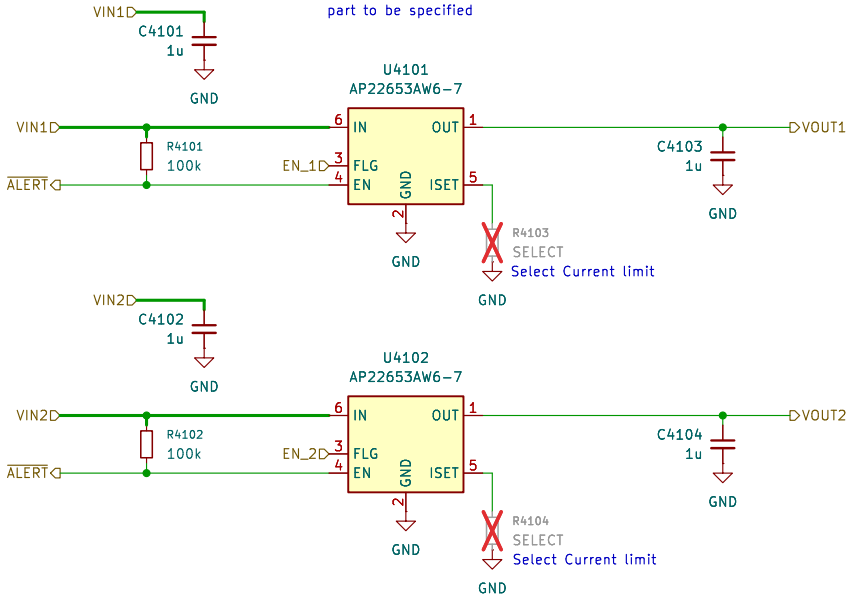
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 12/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

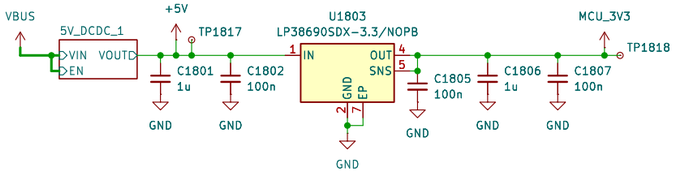
20A
TPS1685
TPS25983
LTC4226

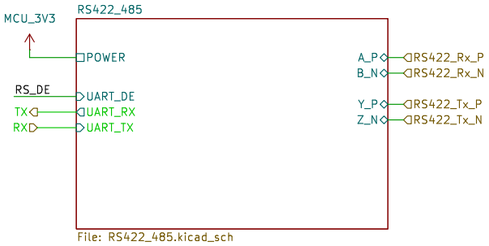


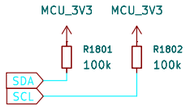
Sheet: /Switch_Deploy_BUS/Switch_element/
File: Switch_element.kicad_sch

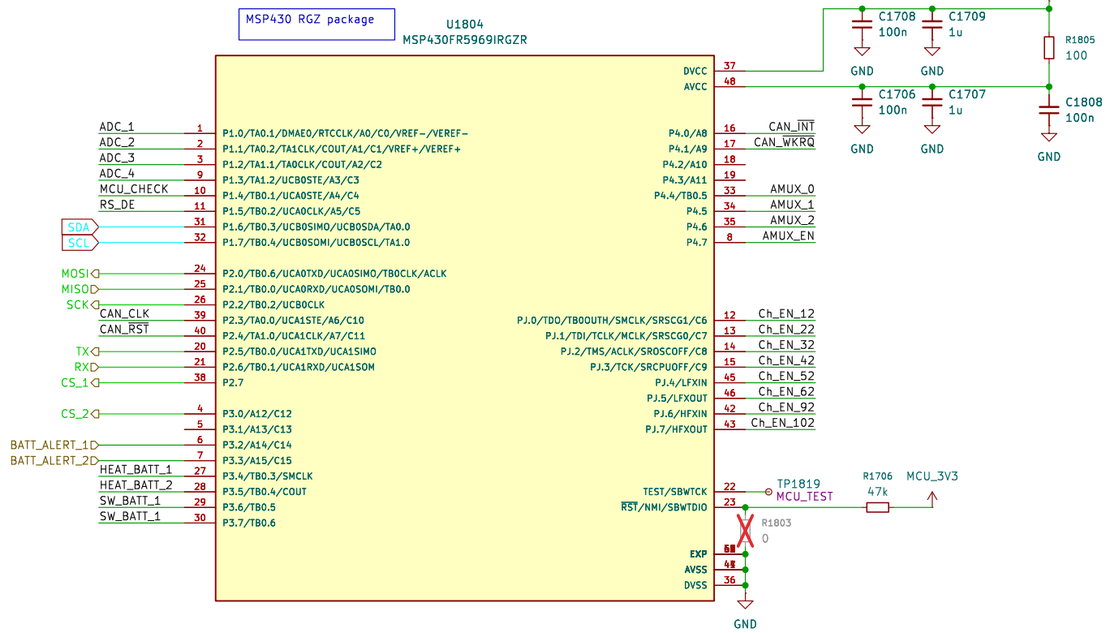
Title:

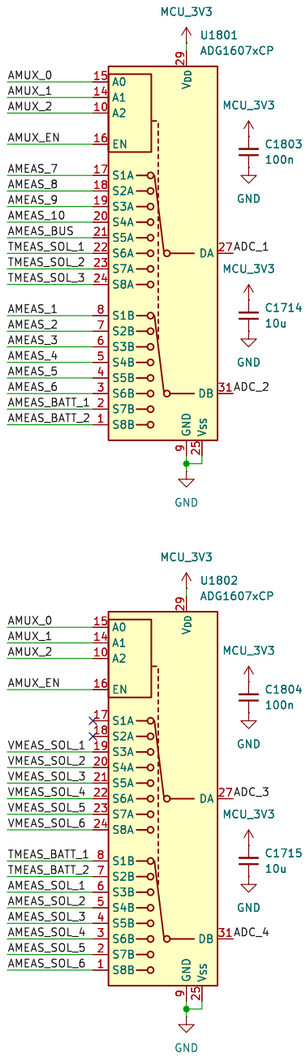
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 43/106

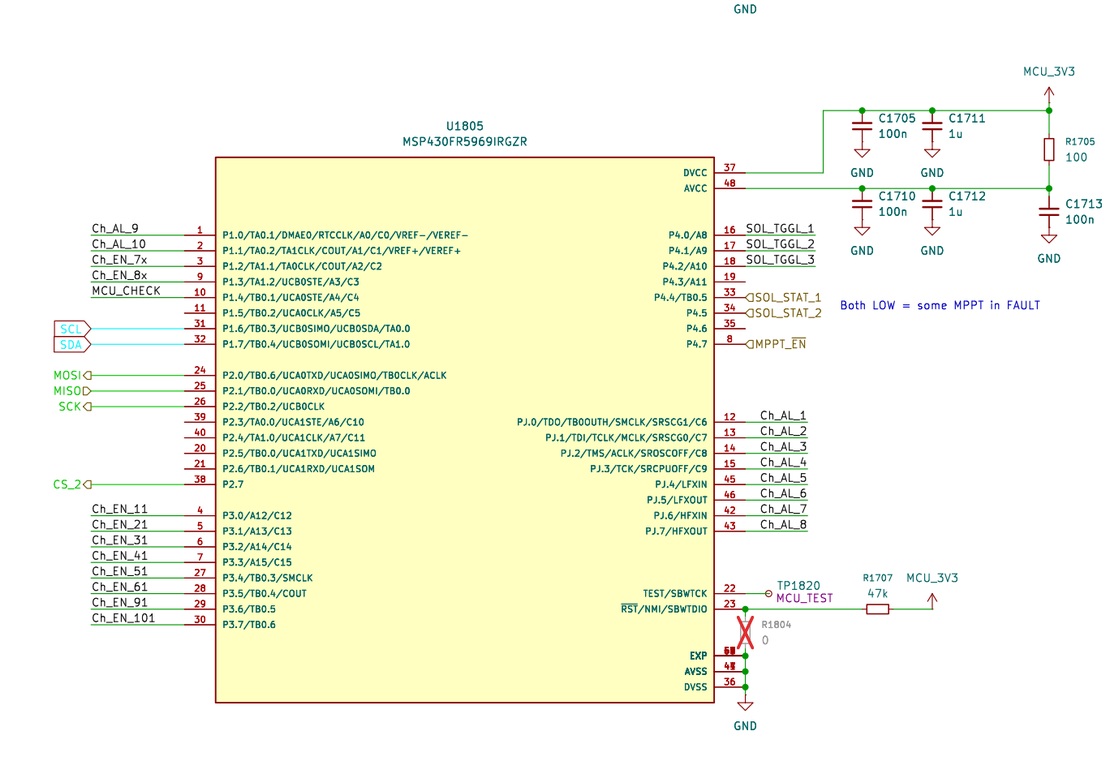


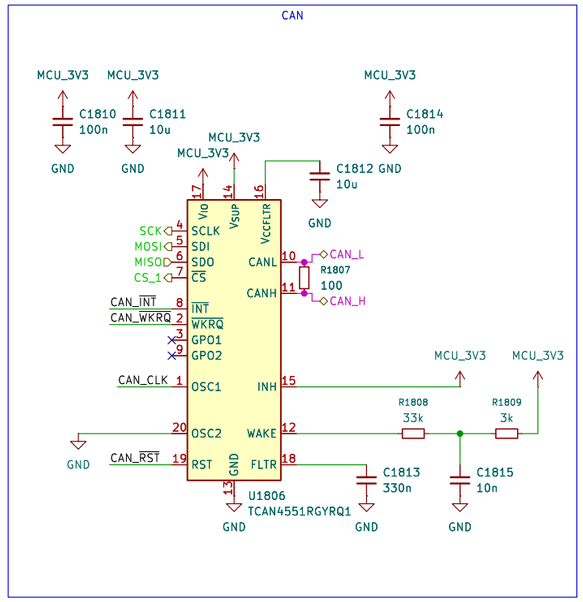












Sheet: /MCU/	
File: MCU.kicad_sch	
Title:	
Size: A3	Date:
KiCad E.D.A. 9.0.4	Id: 19/106

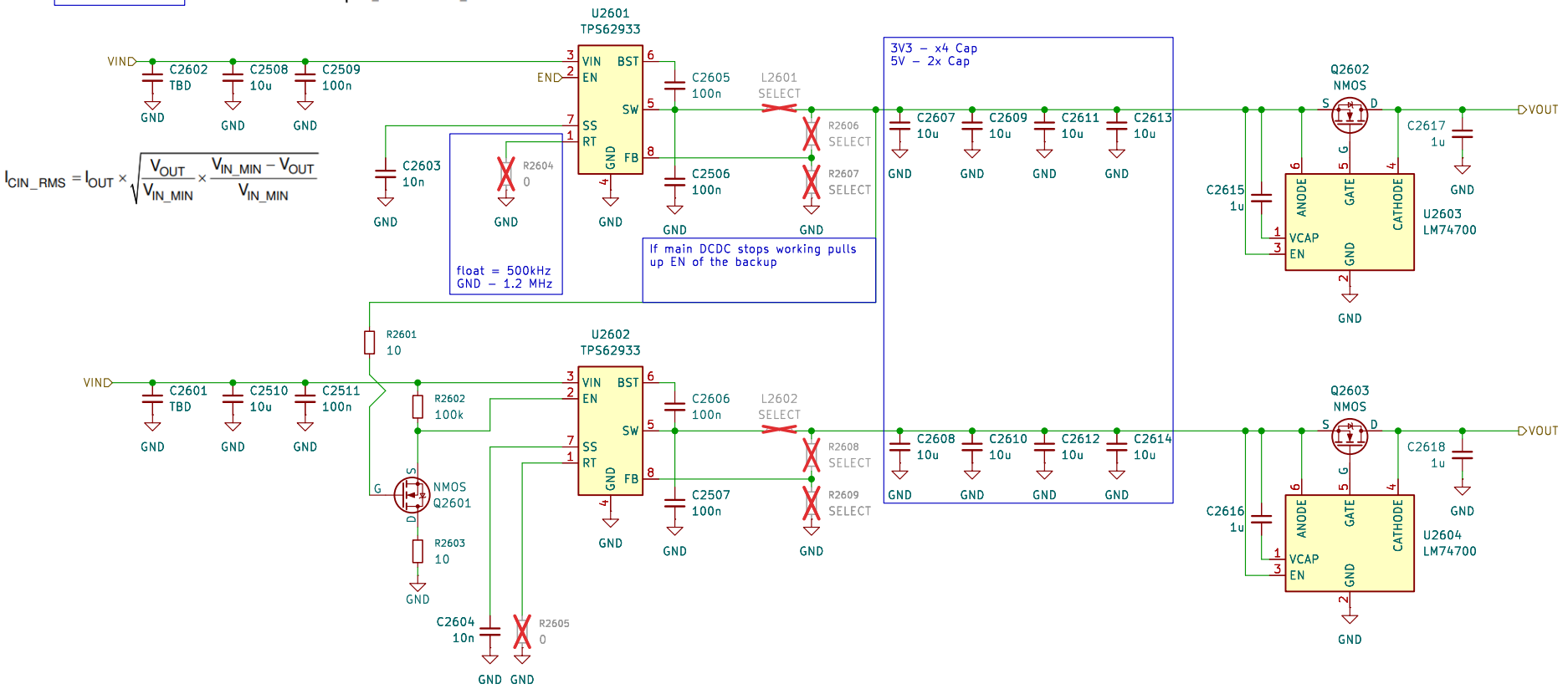
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

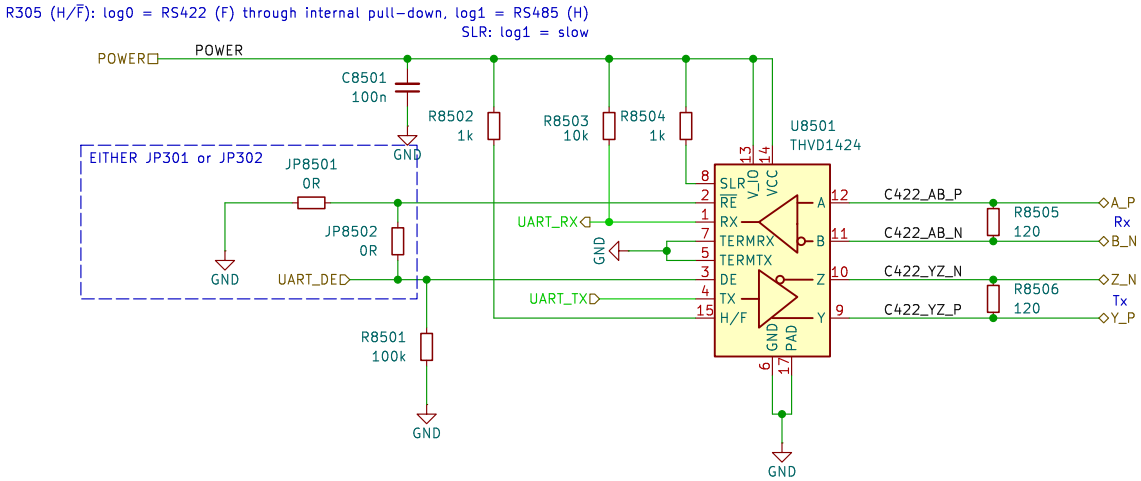
Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /MCU/5V_DCDC_1/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 28/106



Sheet: /MCU/RS422_485/		
File: RS422_485.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 89/106

Regulated channels

Voltage to be chosen on individual converter level

VBUS
5V_DCDC_1 (VIN, VOUT, EN)
Switch_CH_1 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_1 (VIN, VOUT, AMEAS)
R1906 0
Channel_1
Ch_AL_1
Ch_EN_11
Ch_EN_12
AMEAS_1
File: Switch_C.kicad_sch

VBUS
5V_DCDC_2 (VIN, VOUT, EN)
Switch_CH_2 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_2 (VIN, VOUT, AMEAS)
R1901 0
Channel_2
Ch_AL_2
Ch_EN_21
Ch_EN_22
AMEAS_2
File: Switch_C.kicad_sch

VBUS
5V_DCDC_3 (VIN, VOUT, EN)
Switch_CH_3 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_3 (VIN, VOUT, AMEAS)
R1902 0
Channel_3
Ch_AL_3
Ch_EN_31
Ch_EN_32
AMEAS_3
File: Switch_C.kicad_sch

VBUS
5V_DCDC_4 (VIN, VOUT, EN)
Switch_CH_4 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_4 (VIN, VOUT, AMEAS)
R1903 0
Channel_4
Ch_AL_4
Ch_EN_41
Ch_EN_42
AMEAS_4
File: Switch_C.kicad_sch

VBUS
5V_DCDC_5 (VIN, VOUT, EN)
Switch_CH_5 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_5 (VIN, VOUT, AMEAS)
R1904 0
Channel_5
Ch_AL_5
Ch_EN_51
Ch_EN_52
AMEAS_5
File: Switch_C.kicad_sch

VBUS
5V_DCDC_6 (VIN, VOUT, EN)
Switch_CH_6 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_6 (VIN, VOUT, AMEAS)
R1905 0
Channel_6
Ch_AL_6
Ch_EN_61
Ch_EN_62
AMEAS_6
File: Switch_C.kicad_sch

+5V
C1901 1u
C1902 100n
GND
U1901
LP38690SDX-3.3/NOPB
IN, OUT, SNS, GND, EP
C1903 100n
C1904 1u
C1905 100n
+3V3
GND

VBUS
5V_DCDC_7 (VIN, VOUT, EN)
Switch_CH_7 (VIN1, VIN2, VOUT, ALERT, EN)
AMEAS_7 (VIN, VOUT, AMEAS)
R1907 0
Channel_7
Ch_AL_7
Ch_EN_7x
AMEAS_7
File: Switch_H.kicad_sch

VBUS
5V_DCDC_8 (VIN, VOUT, EN)
Switch_CH_8 (VIN1, VIN2, VOUT, ALERT, EN)
AMEAS_8 (VIN, VOUT, AMEAS)
R1908 0
Channel_8
Ch_AL_8
Ch_EN_8x
AMEAS_8
File: Switch_H.kicad_sch

{Channels}
Channel
Channel_1
Channel_2
Channel_3
Channel_4
Channel_5
Channel_6
Channel_7
Channel_8
Channel_9
Channel_10

{AMEAS}
AMEAS_1
AMEAS_2
AMEAS_3
AMEAS_4
AMEAS_5
AMEAS_6
AMEAS_7
AMEAS_8
AMEAS_9
AMEAS_10

{Enables}
Ch_EN_11
Ch_EN_12
Ch_EN_21
Ch_EN_22
Ch_EN_31
Ch_EN_32
Ch_EN_41
Ch_EN_42
Ch_EN_51
Ch_EN_52
Ch_EN_61
Ch_EN_62
Ch_EN_7x
Ch_EN_8x
Ch_EN_91
Ch_EN_92
Ch_EN_101
Ch_EN_102

{ALERTS}
Ch_AL_1
Ch_AL_2
Ch_AL_3
Ch_AL_4
Ch_AL_5
Ch_AL_6
Ch_AL_7
Ch_AL_8
Ch_AL_9
Ch_AL_10

VBUS channels

VBUS
Switch_CH_9 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_9 (VIN, VOUT, AMEAS)
R1909 0
Channel_9
Ch_AL_9
Ch_EN_91
Ch_EN_92
AMEAS_9
File: Switch_C.kicad_sch

VBUS
Switch_CH_10 (VIN, VOUT, ALERT, EN_1, EN_2)
AMEAS_10 (VIN, VOUT, AMEAS)
R1910 0
Channel_10
Ch_AL_10
Ch_EN_101
Ch_EN_102
AMEAS_10
File: Switch_C.kicad_sch

Sheet: /Channel_Matrix/
File: Channel_Matrix.kicad_sch
Title:
Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 20/106

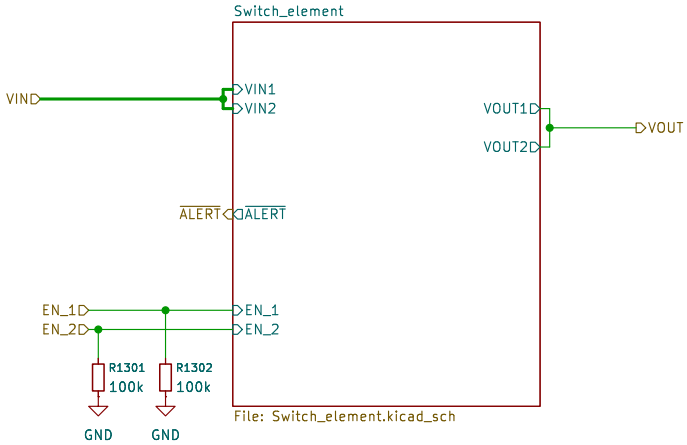
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_9/
File: Switch_C.kicad_sch

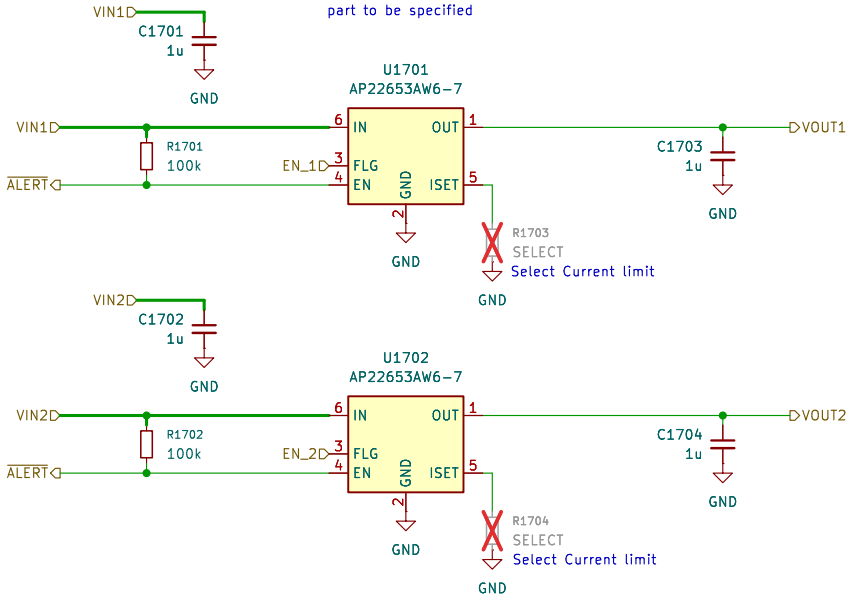
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 13/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_9/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 18/106

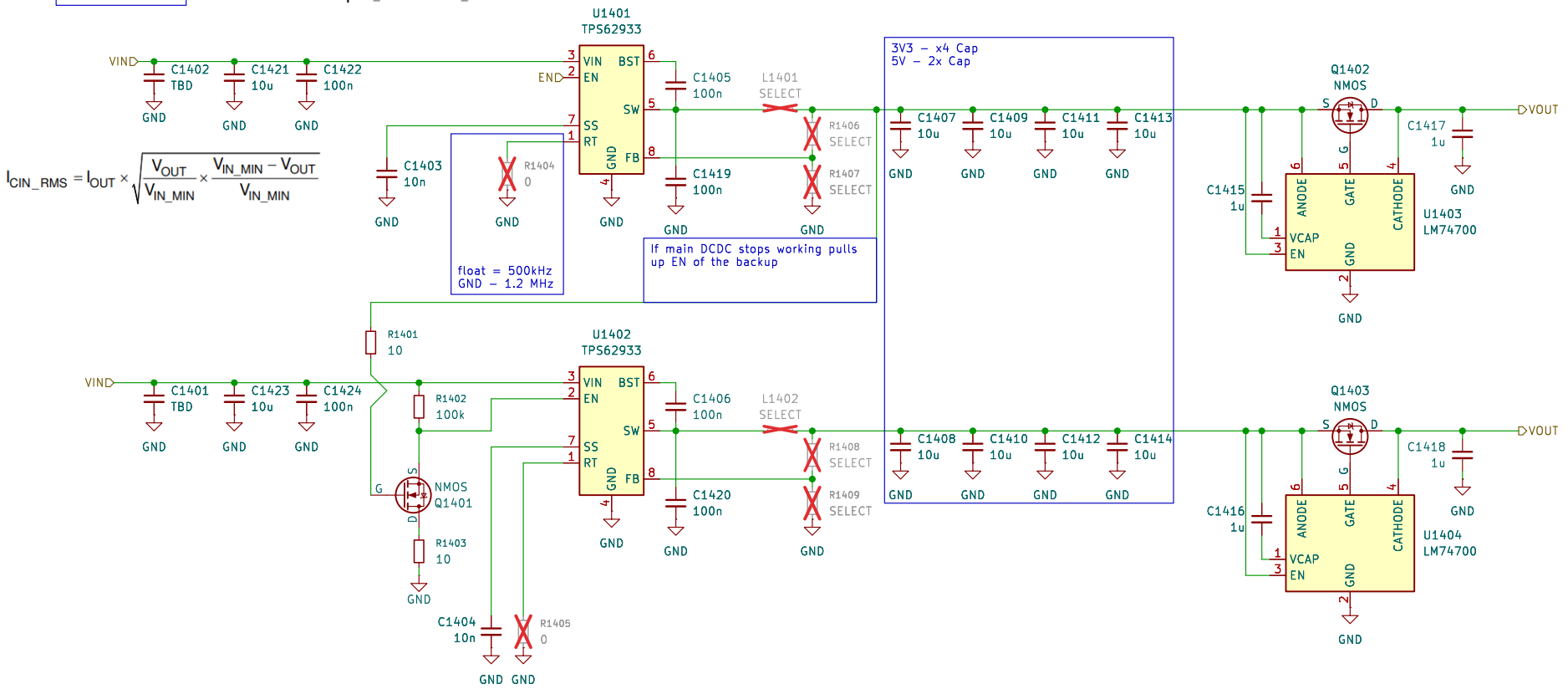
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_8/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 14/106

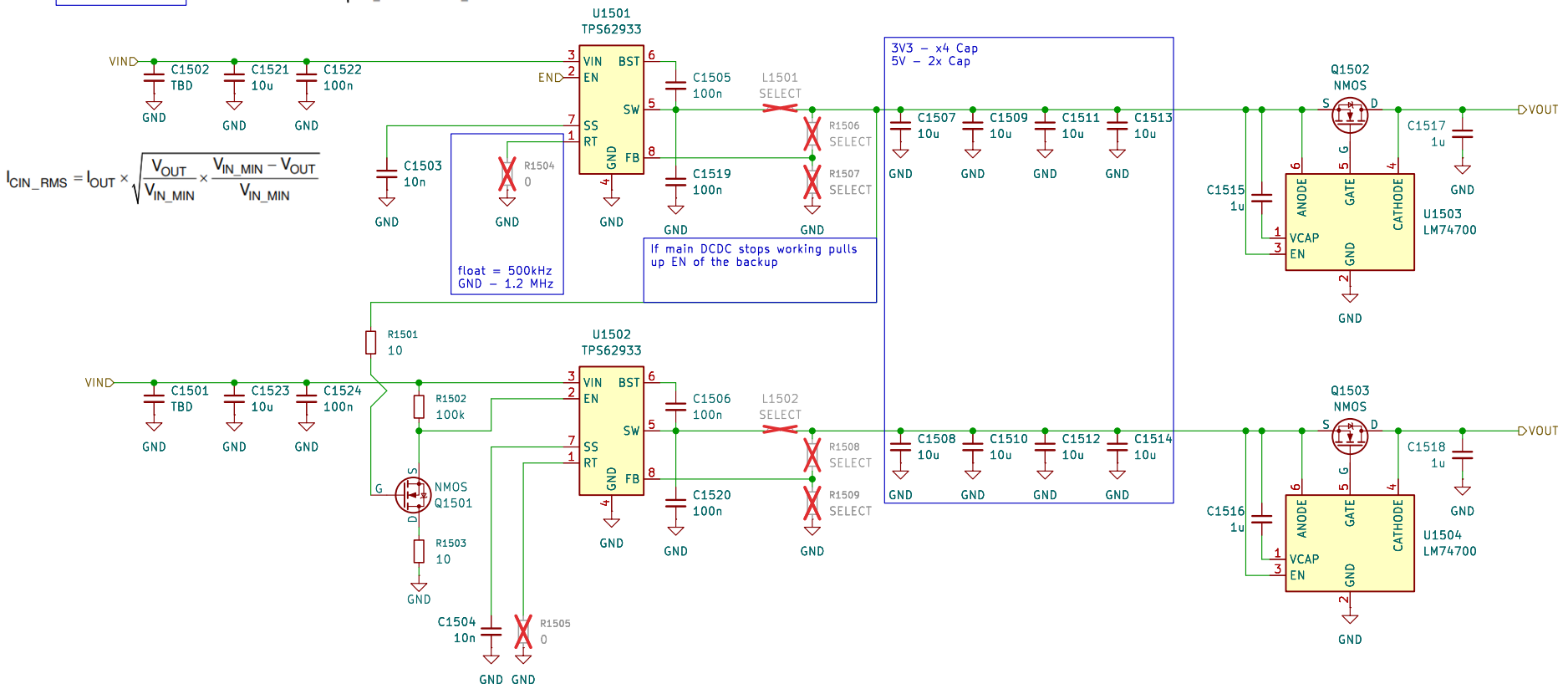
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_1/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 15/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

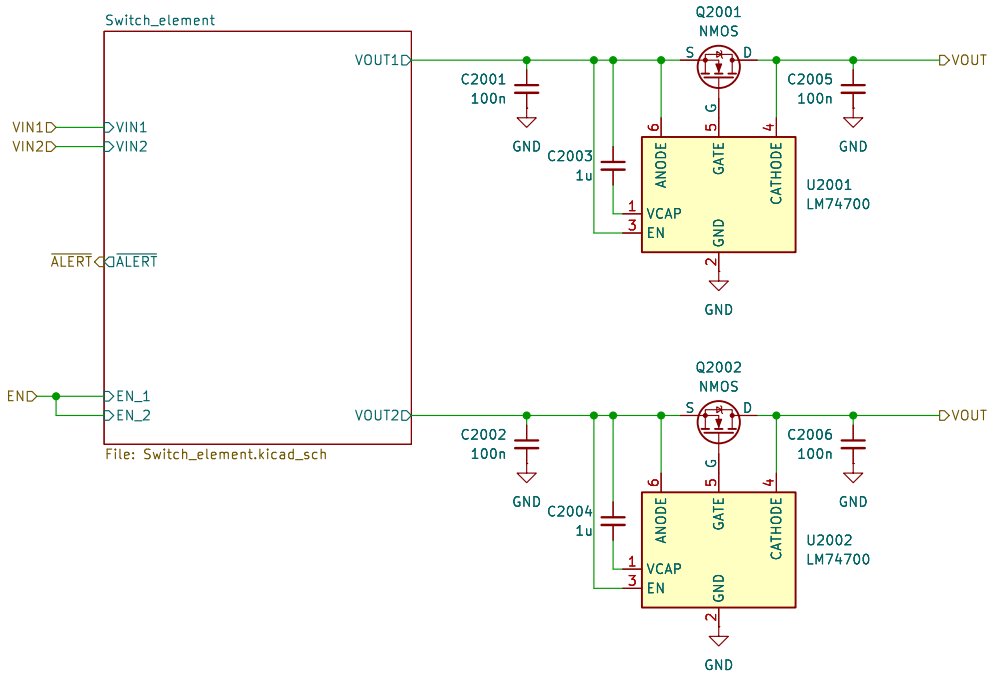
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_7/
File: Switch_H.kicad_sch

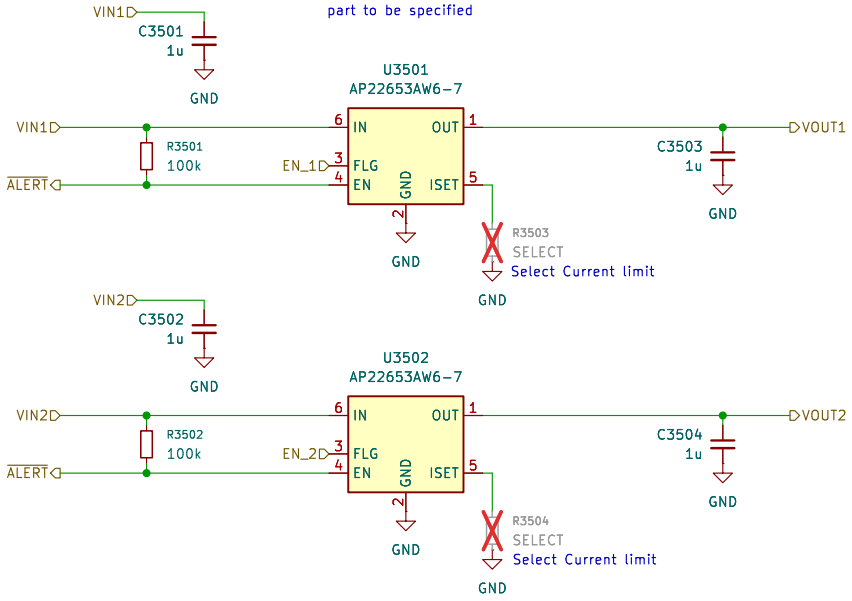
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 21/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_7/Switch_element/		
File: Switch_element.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 37/106

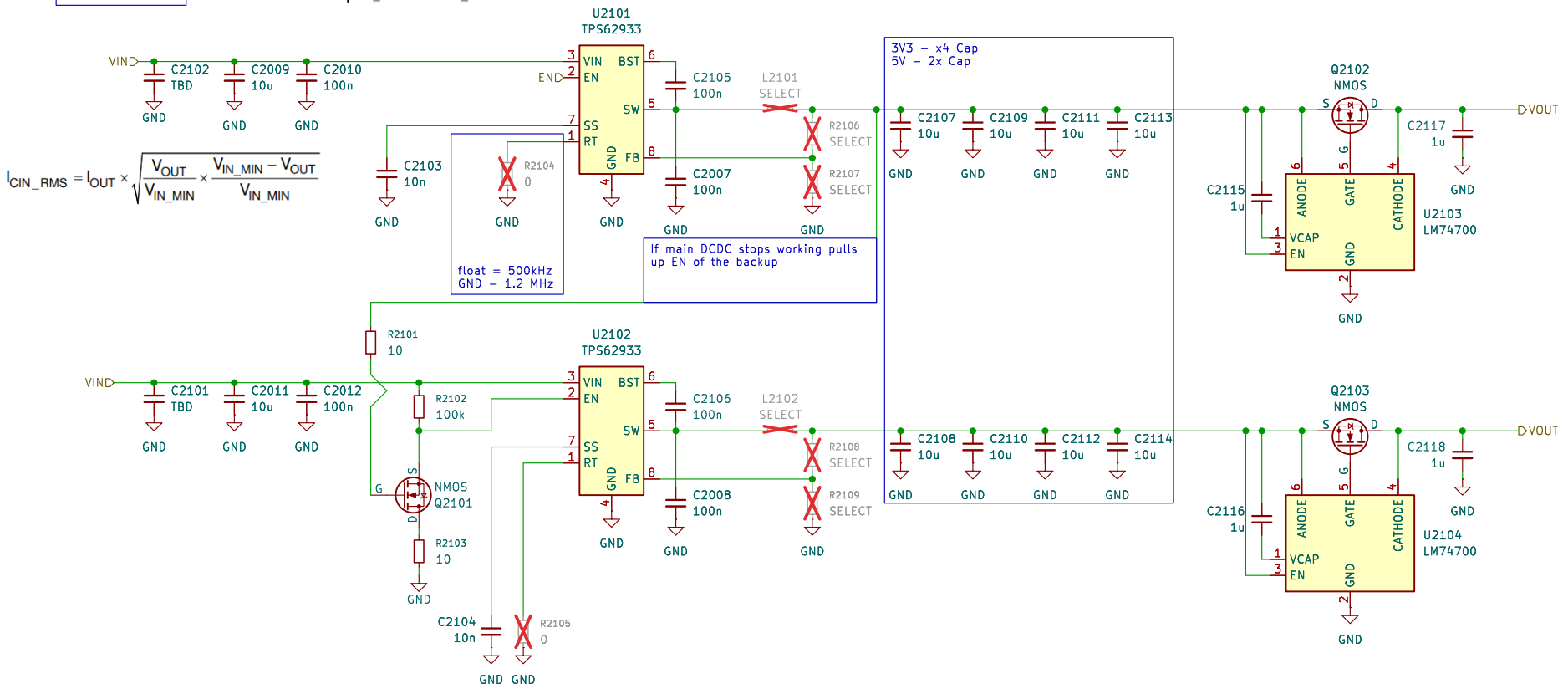
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_7/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 23/106

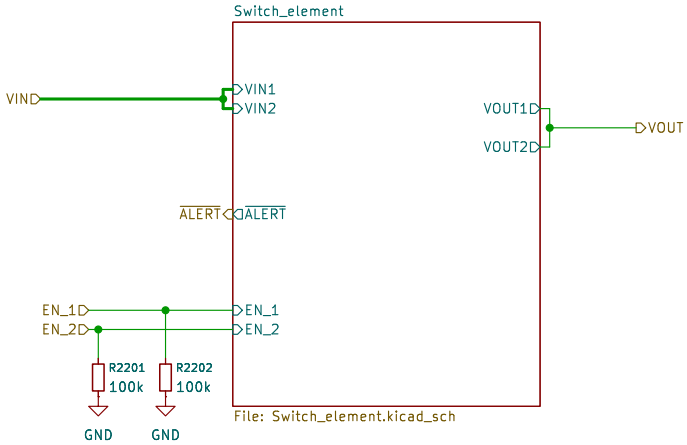
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_10/
File: Switch_C.kicad_sch

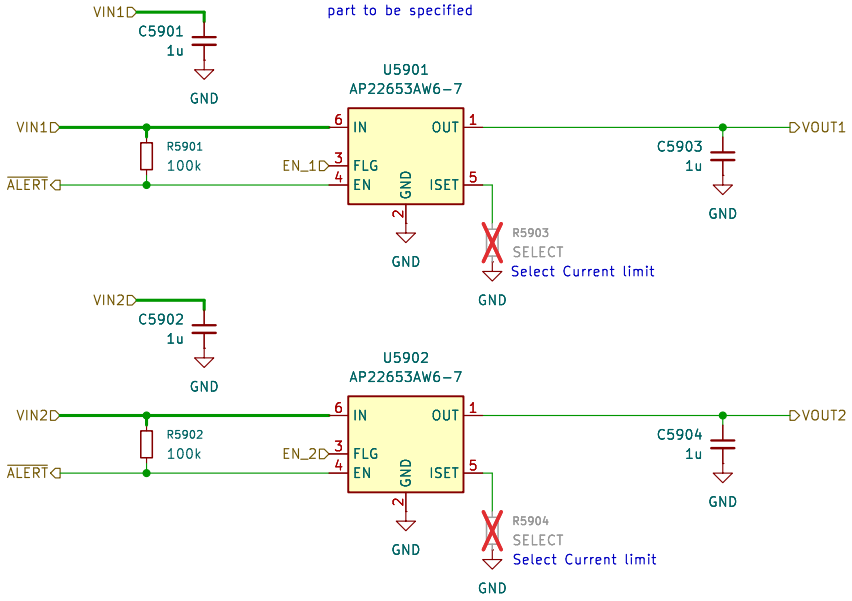
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 24/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_10/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 61/106

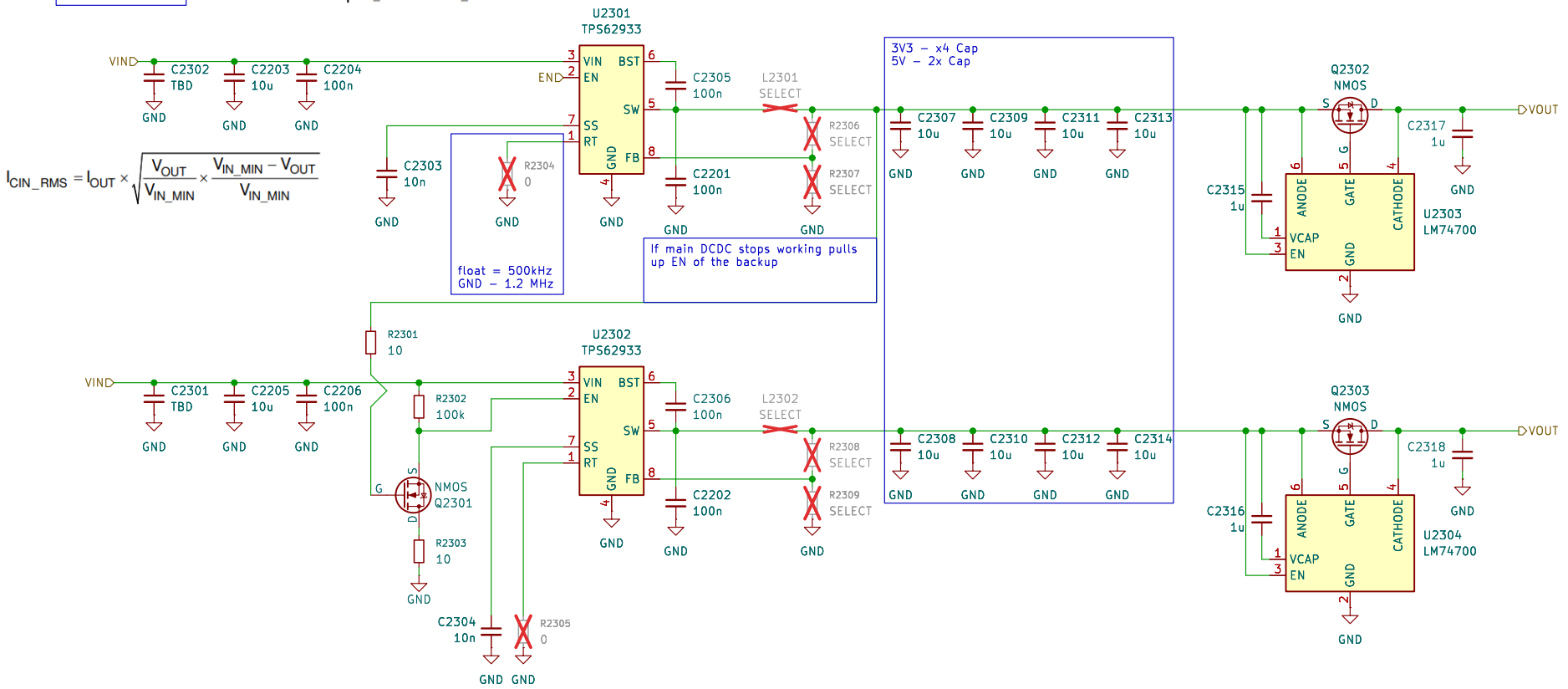
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_2/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 25/106

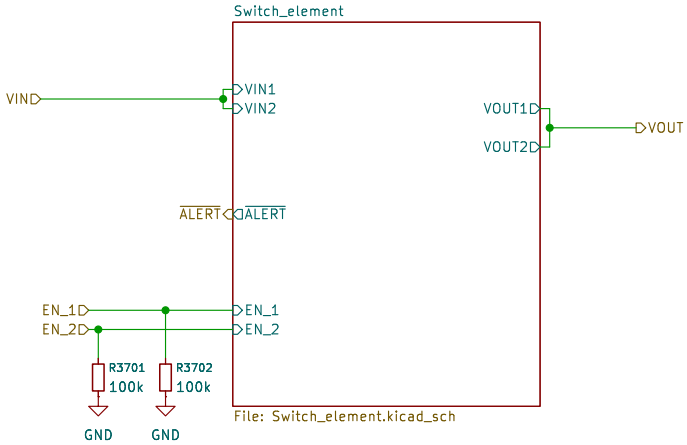
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_1/
File: Switch_C.kicad_sch

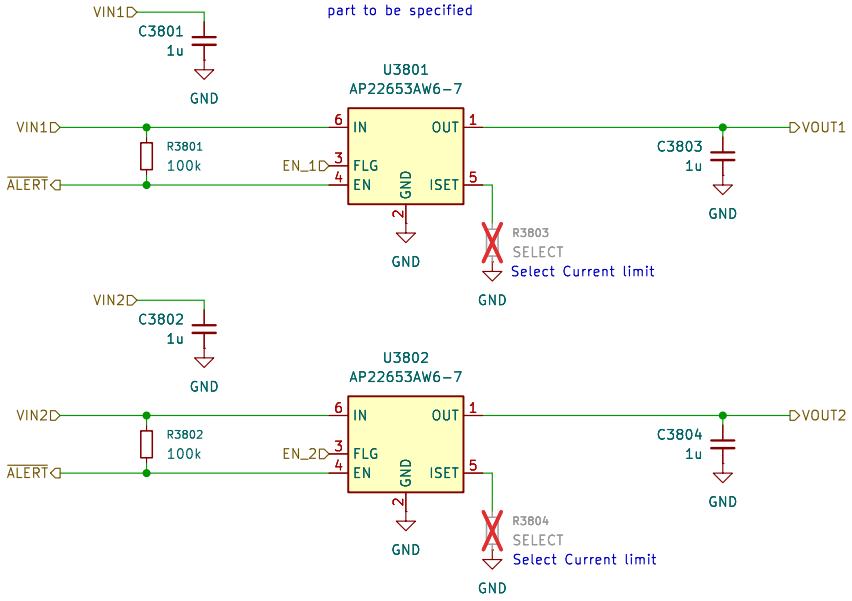
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 39/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 40/106

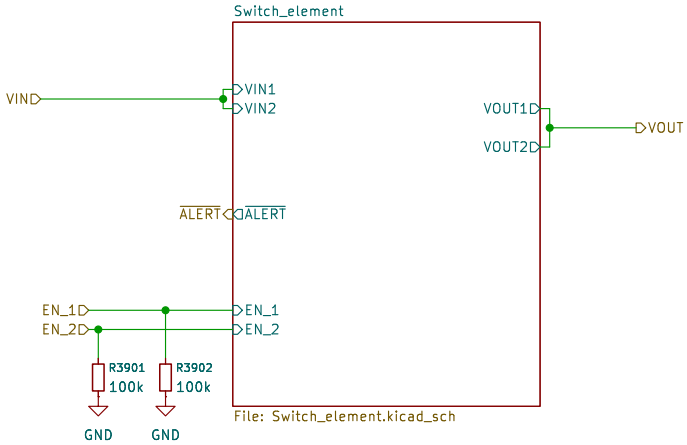
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_2/
File: Switch_C.kicad_sch

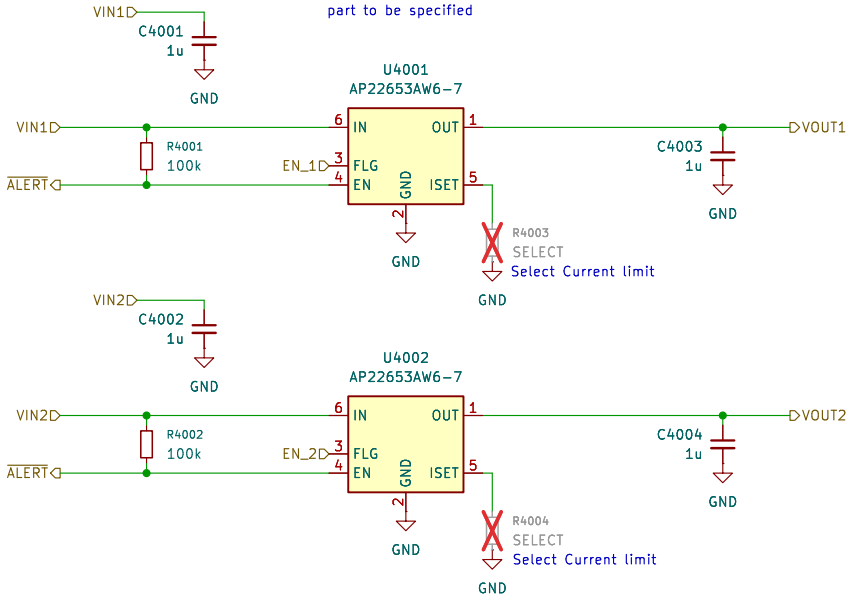
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 41/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_2/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 42/106

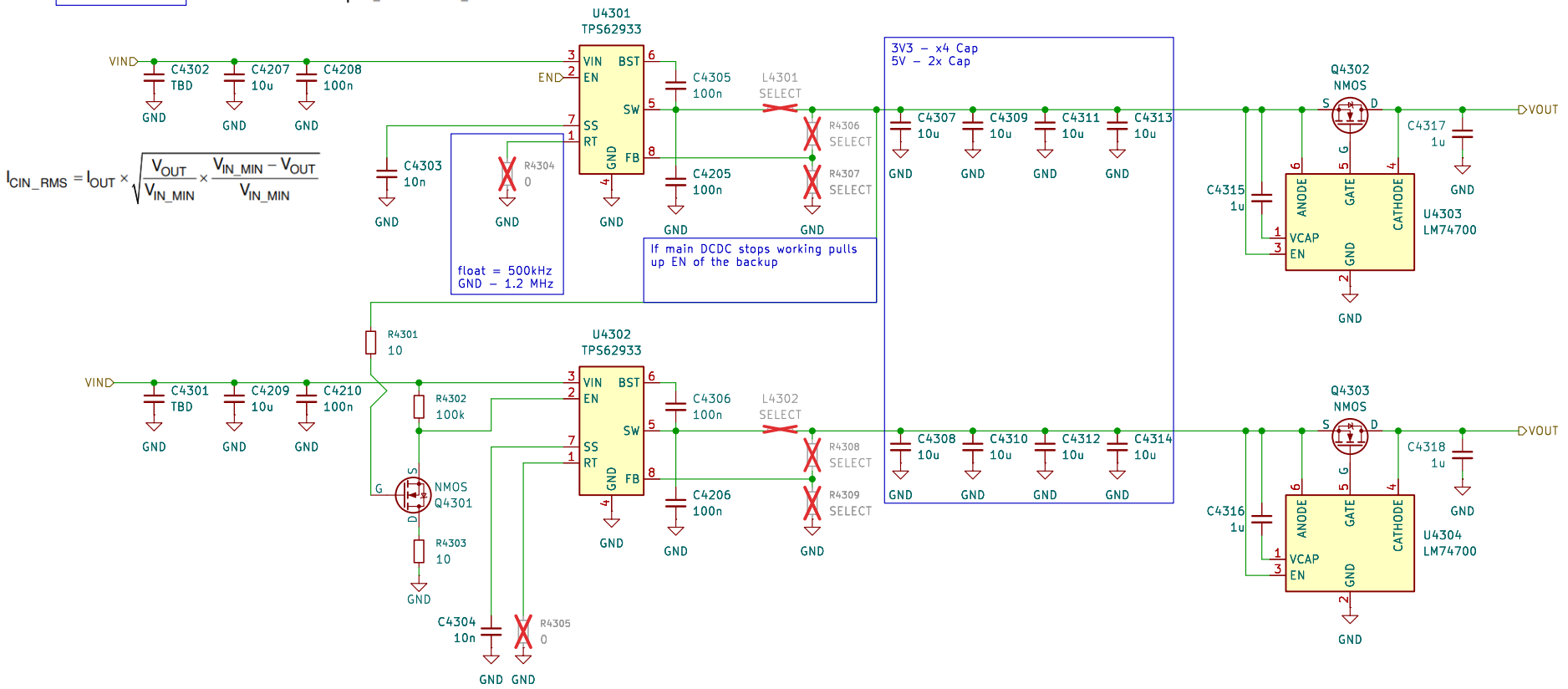
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_6/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 45/106

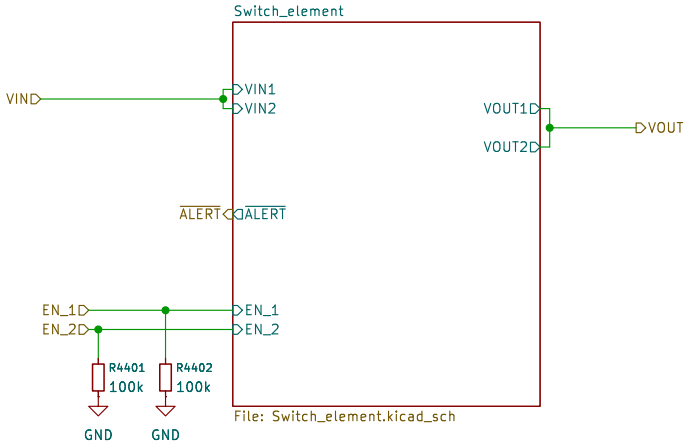
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_6/
File: Switch_C.kicad_sch

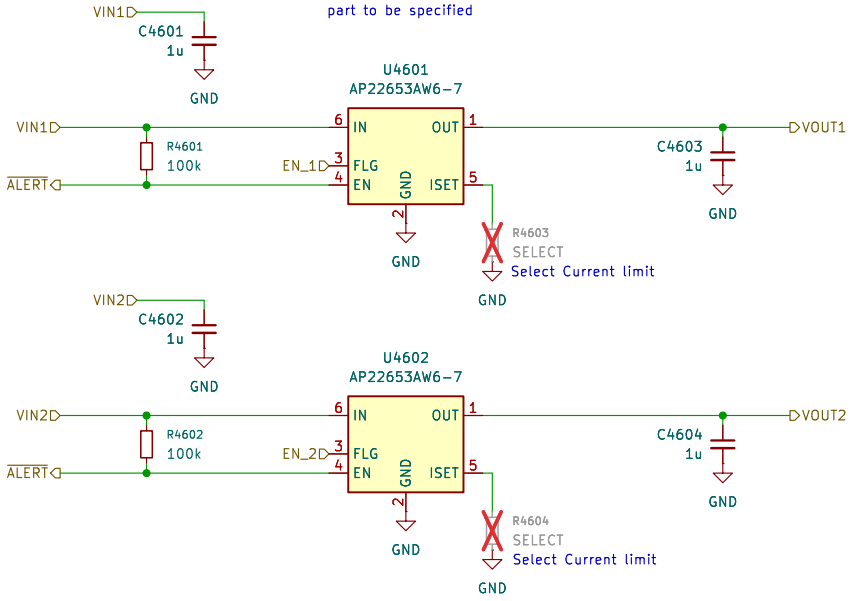
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 46/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_6/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 48/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

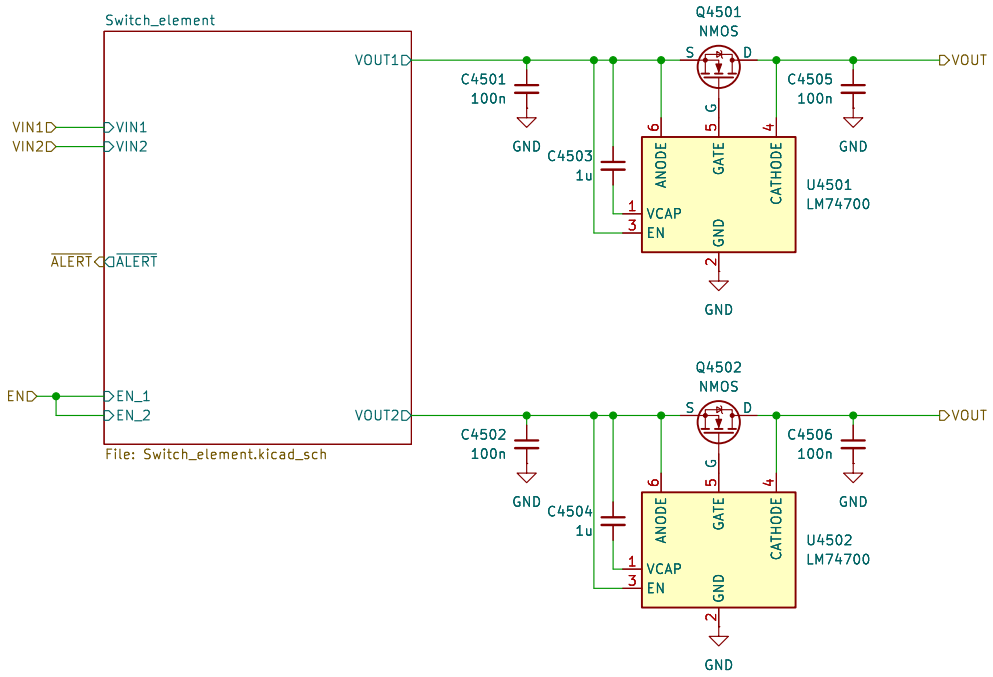
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_8/
File: Switch_H.kicad_sch

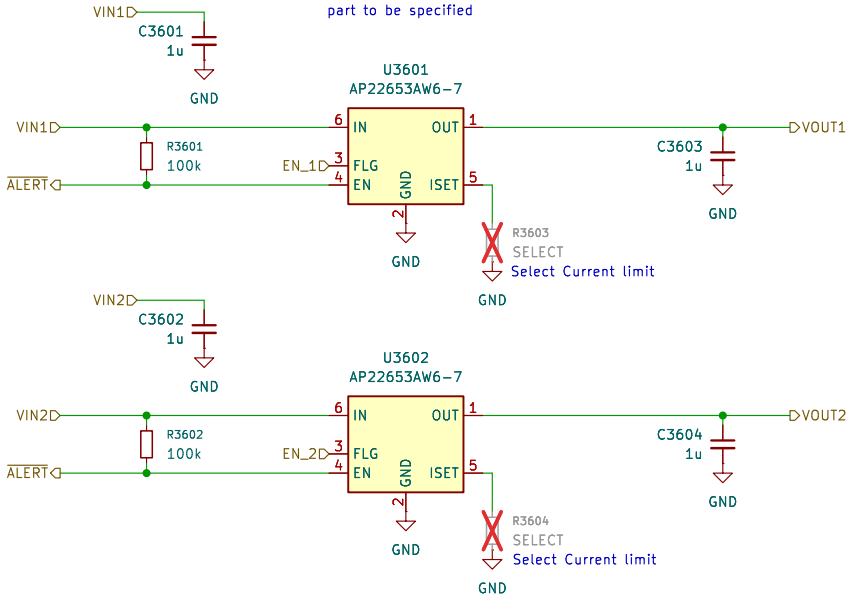
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 47/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_8/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 38/106

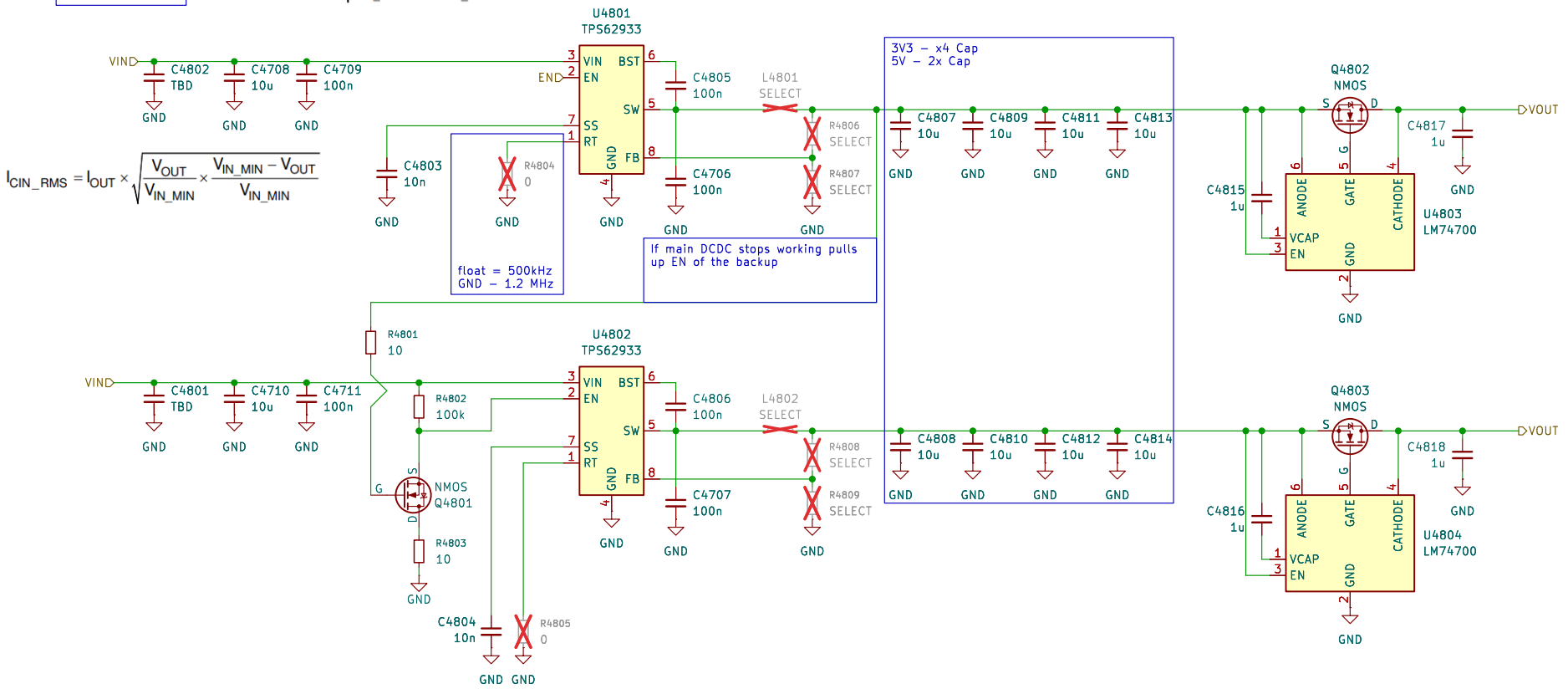
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_5/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 50/106

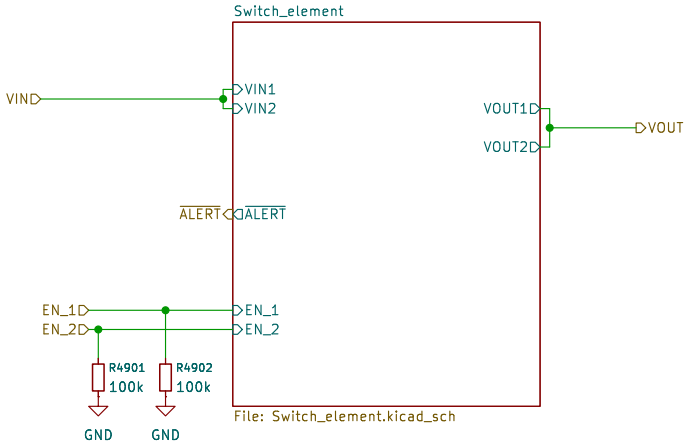
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_5/
File: Switch_C.kicad_sch

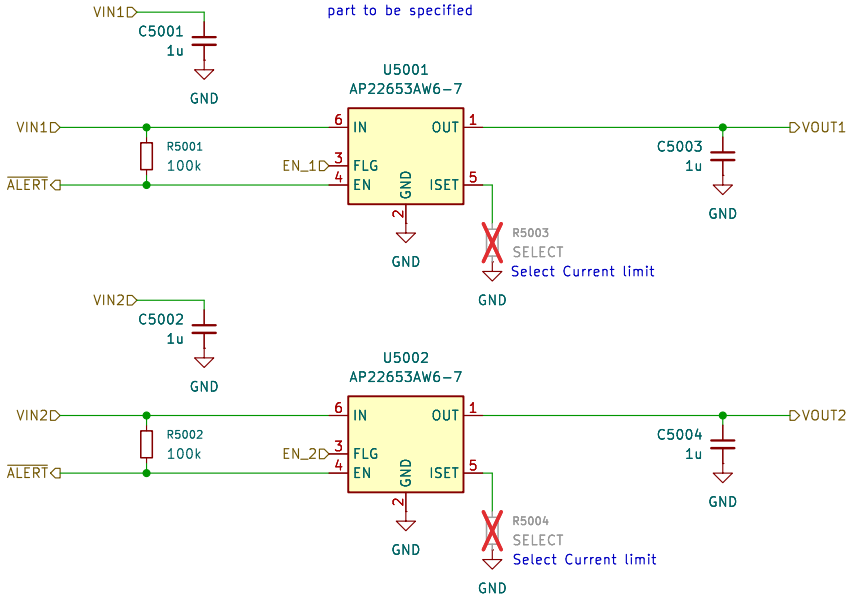
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 51/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_5/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 52/106

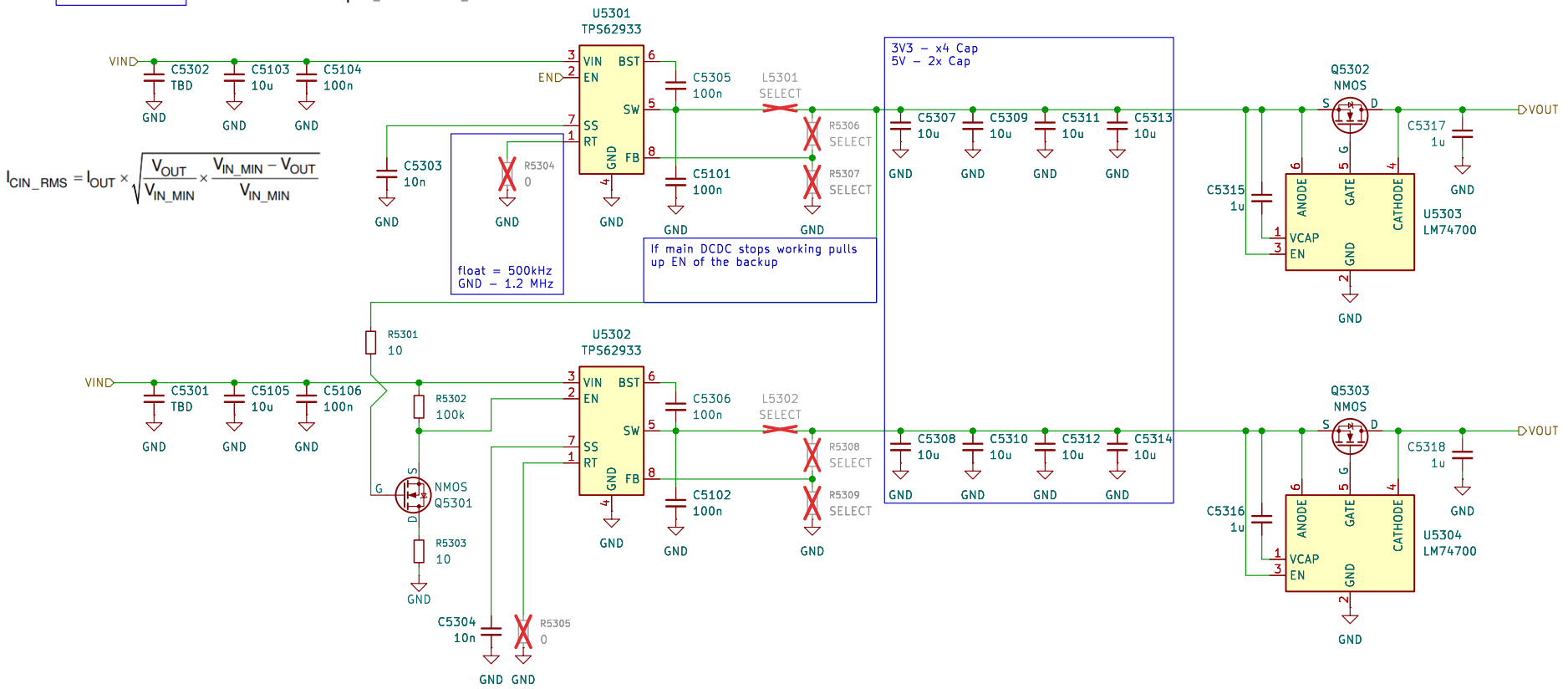
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_4/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 55/106

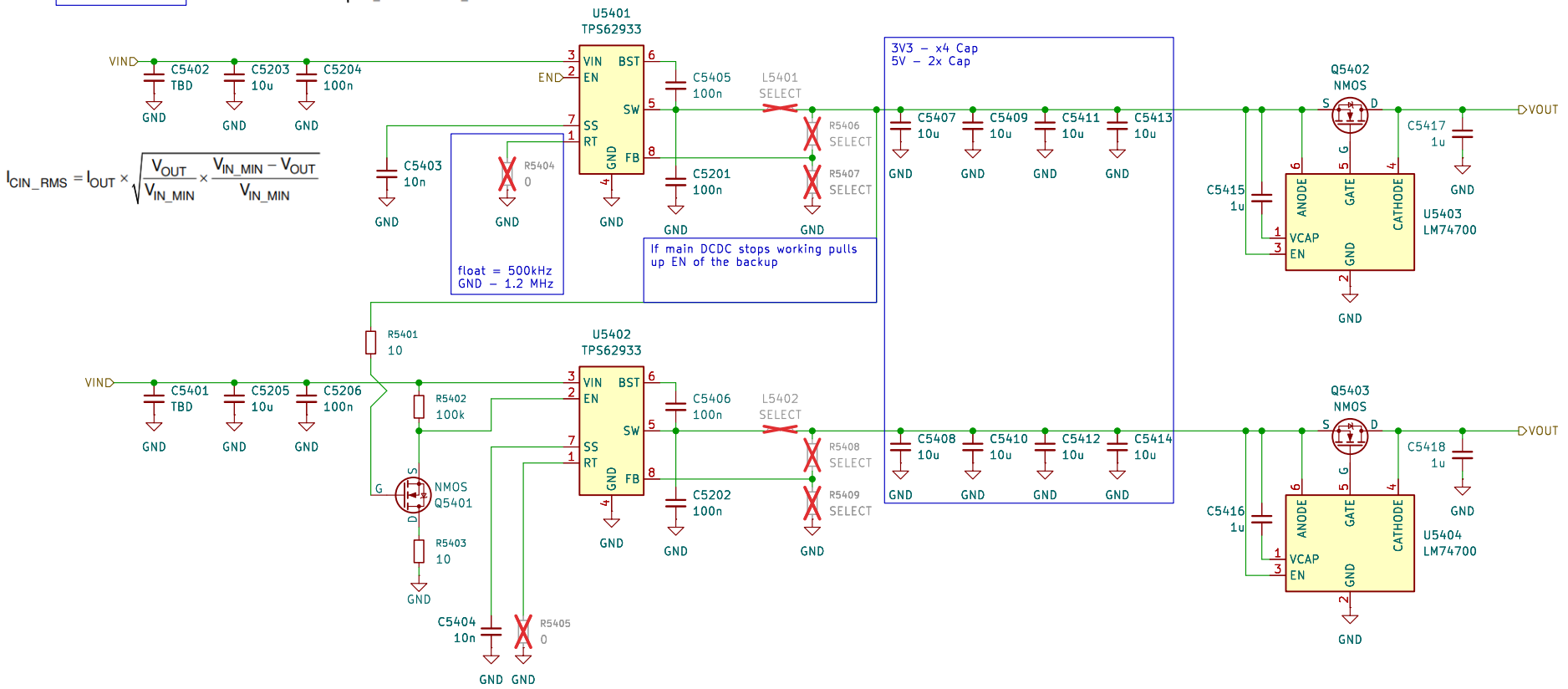
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /Channel_Matrix/5V_DCDC_3/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 56/106

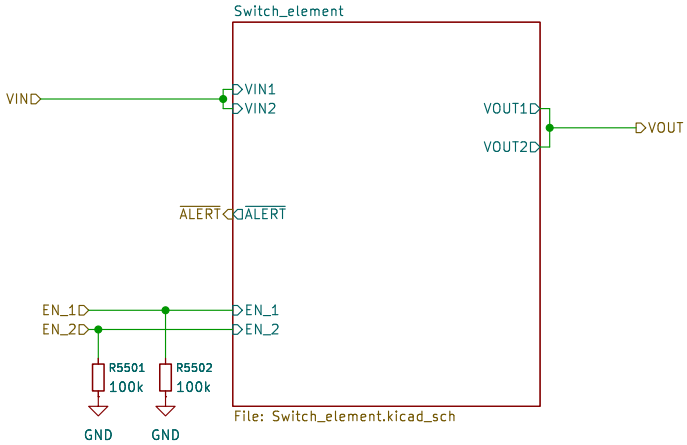
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_3/
File: Switch_C.kicad_sch

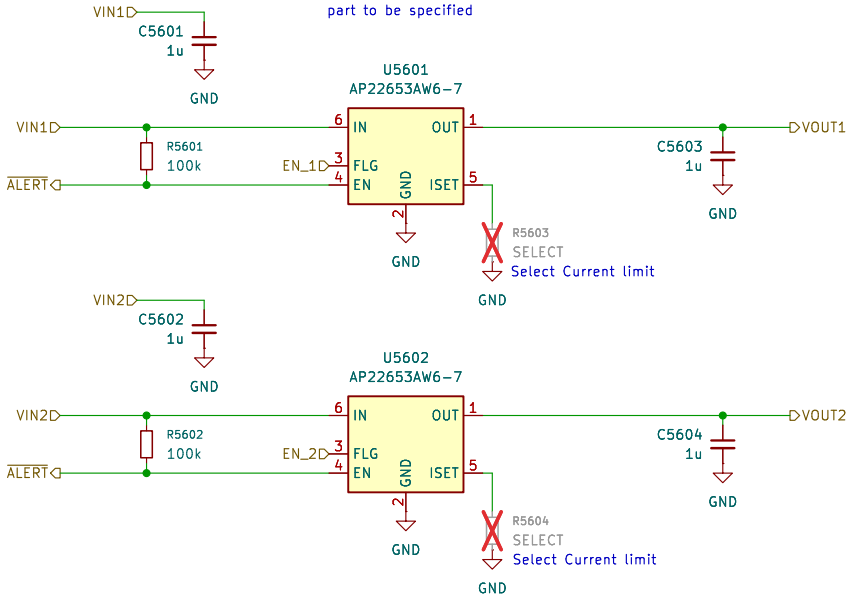
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 57/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

20A
TPS1685
TPS25983
LTC4226



Sheet: /Channel_Matrix/Switch_CH_3/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 58/106

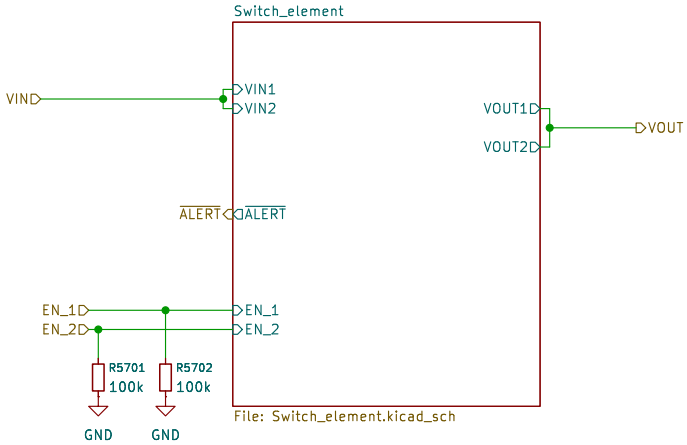
Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Channel_Matrix/Switch_CH_4/
File: Switch_C.kicad_sch

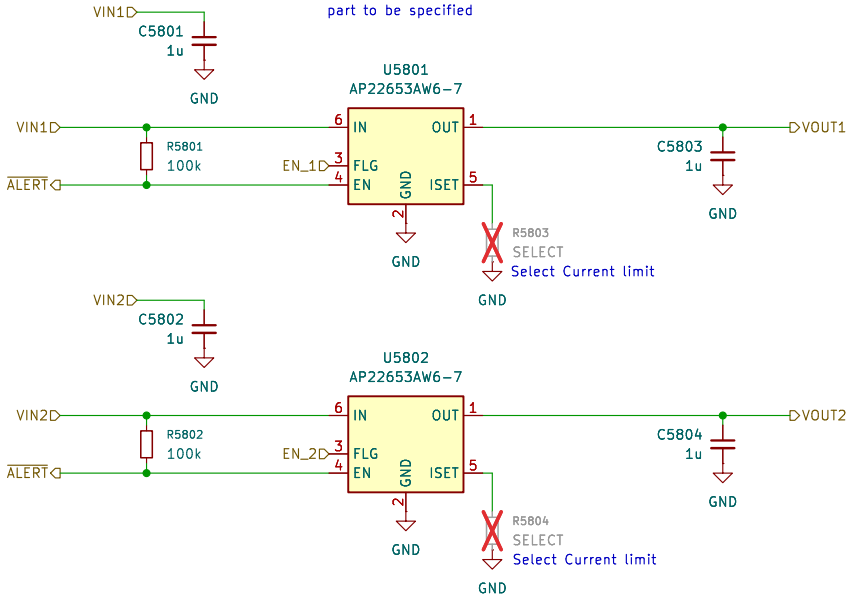
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 59/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

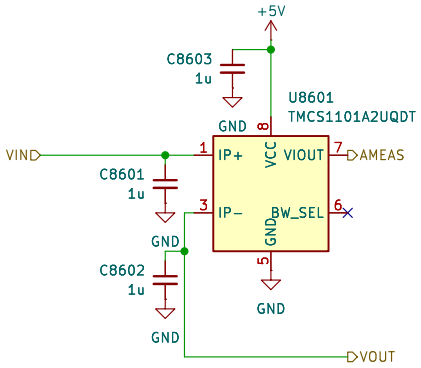
20A
TPS1685
TPS25983
LTC4226



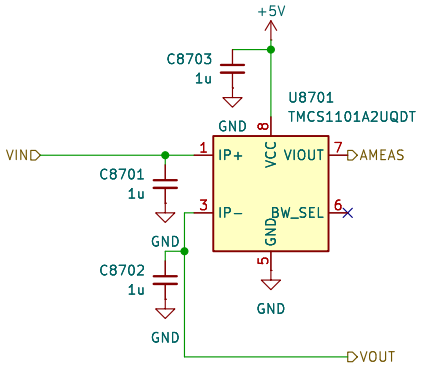
Sheet: /Channel_Matrix/Switch_CH_4/Switch_element/
File: Switch_element.kicad_sch

Title:

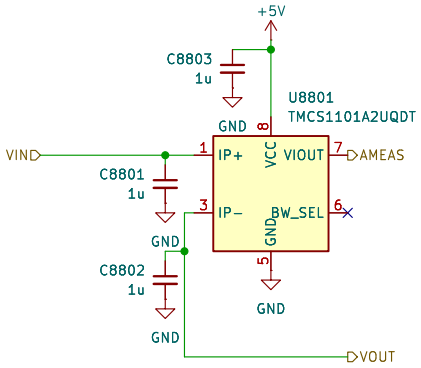
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 60/106



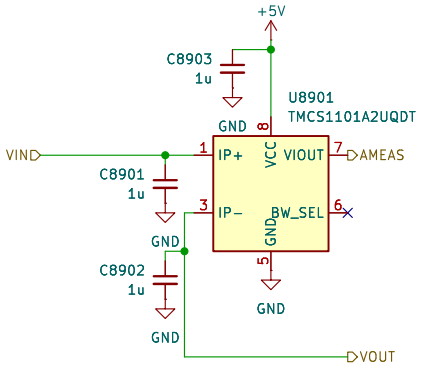
Sheet: /Channel_Matrix/AMEAS_1/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 92/106



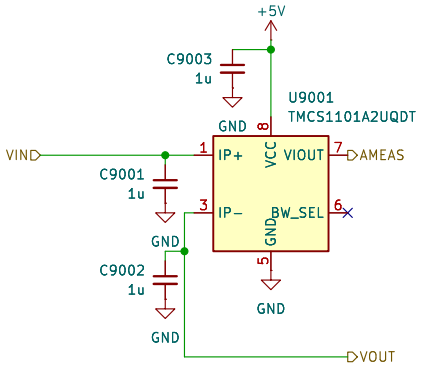
Sheet: /Channel_Matrix/AMEAS_2/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 93/106



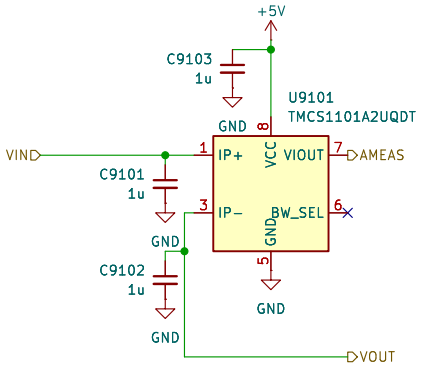
Sheet: /Channel_Matrix/AMEAS_3/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 94/106



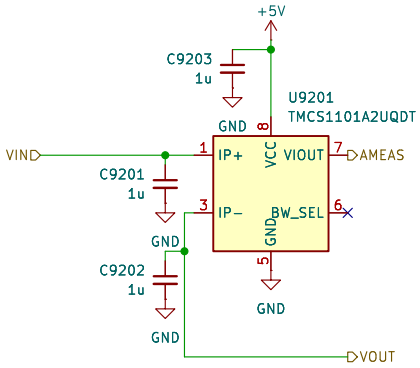
Sheet: /Channel_Matrix/AMEAS_4/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 95/106



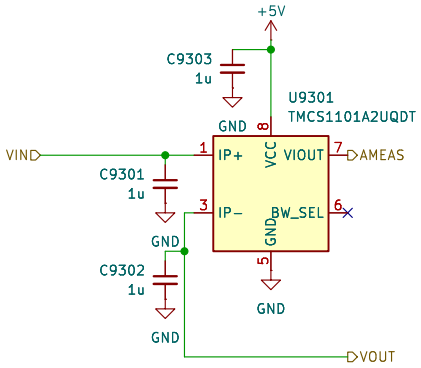
Sheet: /Channel_Matrix/AMEAS_5/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 96/106



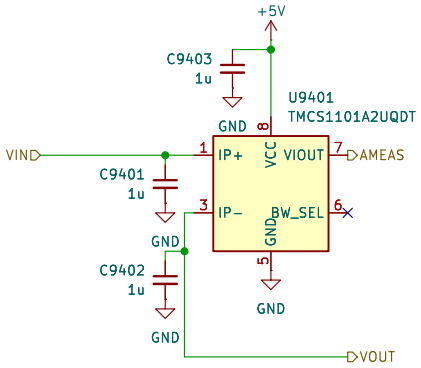
Sheet: /Channel_Matrix/AMEAS_6/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 97/106



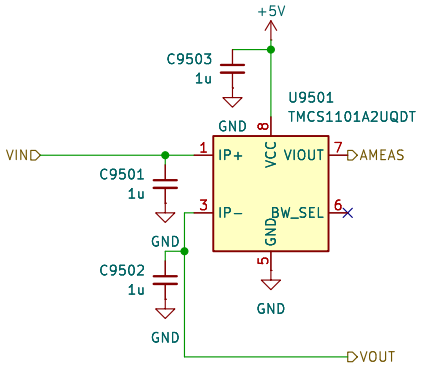
Sheet: /Channel_Matrix/AMEAS_7/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 98/106



Sheet: /Channel_Matrix/AMEAS_8/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 99/106



Sheet: /Channel_Matrix/AMEAS_9/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 100/106



Sheet: /Channel_Matrix/AMEAS_10/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 101/106

Inputs	Outputs
Solar Cell	Ouput voltage
	Measured voltage
	Measured current
	Temperature of the Cell

Input for solar cell with MPPT tracking
reverse current protection.
Temperature measurement

DC/DC controlled using PWM from CPU
to create MPPT function

solar 4S –> voltage > VBUS

MPPT Buck DC/DC

vyhoda Nastaveni
pomoci odporu a ne
ulozeni v registur

Charging current

$I_{CHARGE} = \frac{40\ mV}{R_{SR}}$

$I_{PRECHARGE} = \frac{4\ mV}{R_{SR}}$

PV, TP2901, D2801 D_Schottky, R2905 10, C2905 1u, GND

U2901 BQ24650

R2901 500k, C2901 1u, REGN, C2903 1u

VCC, HIDRV, PH, BTST, REGN, LODRV, VREF, TERM_EN, MPPSET, SRP, SRN, VFB, TS, STAT1, STAT2, GND

Q2902 NMOS, Q2903 NMOS, C2904 1u, L2901 TBD, R2908 20m, C2906 1u, C2908 1u

D2901 D_Schottky, C2902 1u

Termistor for monitoring
should be bypassed
with EN signal from MCU

R2903 40k, TP2902, Term, R2904 60k

V term set to 60% –>
charging is always ON

TP2903

Disable
Charging

EN, CE, Q2901 NMOS, R2902 36k

MPPTSET is regulated at 1.2V

$V_{MPPSET} = 1.2\ V \times \left[1 + \frac{R3}{R4}\right]$

+5V+5V, R2906 100k, R2907 100k, STAT_1, STAT_2

TP2904, C2907 1u, R2909 500k, R2910 67k

$V_{BAT} = 2.1\ V \times \left[1 + \frac{R2}{R1}\right]$

where
- R2 is connected from VFB to the battery
- and R1 is connected from VFB to GND.

Output battery
voltage adj
2.1V on VFB

Switch_SOL_1, VIN1, VIN2, VOUT, ALERT, EN

R2911 100k, R2912 1k

Toggles between fixed and MPPT
Default: fixed

TOGGLED, TP2905

Switch_SOL_2, FIXED_IN, R2915 100k, R2913 10, R2916 1k, R2914 100k, NMOS Q2904

AMEAS_1, PV_IN, VIN, VOUT, PV, AMEASD, AMEAS

PV, R2809 1M, VMEAS, R2810 1M, GND

Temp_sens_solar_cell, TMEASD, TMEAS

File: Temp_sens.kicad_sch

Sheet: /Solar_input_4/
File: Solar_Cell_Input.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 31/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

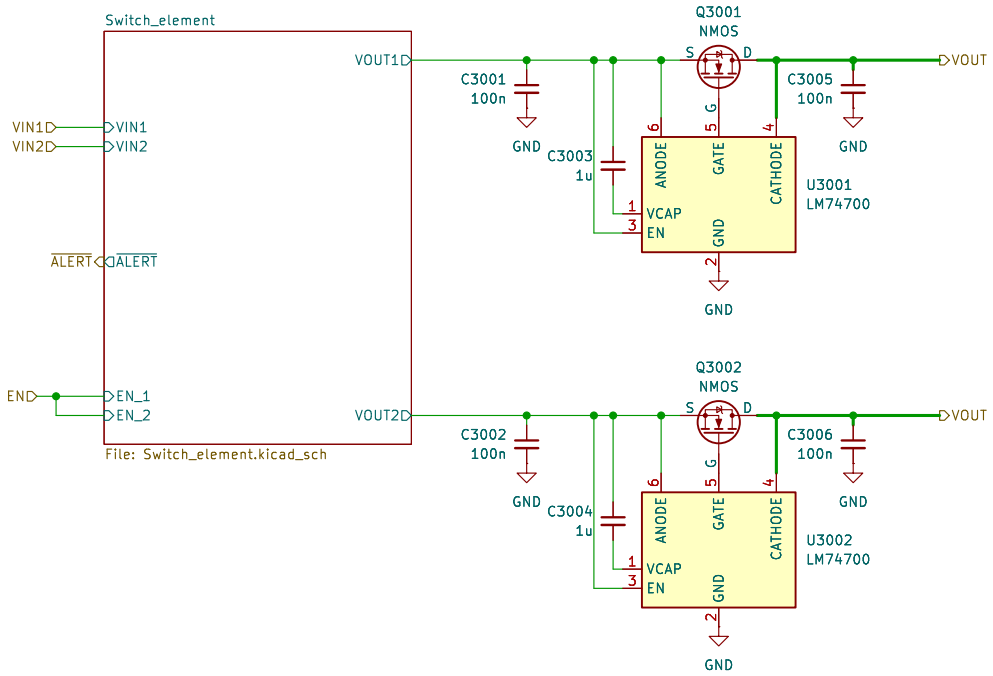
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_4/Switch_SOL_1/
File: Switch_H.kicad_sch

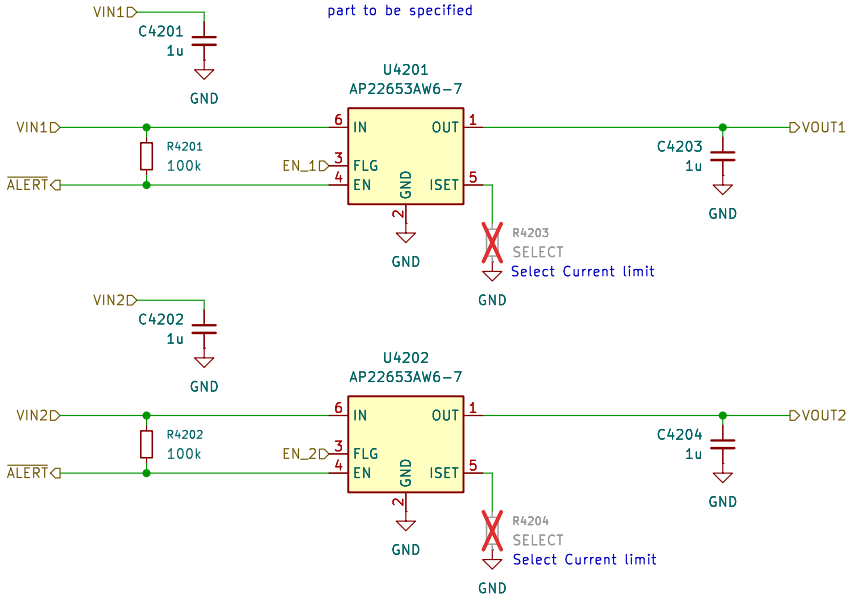
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 32/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

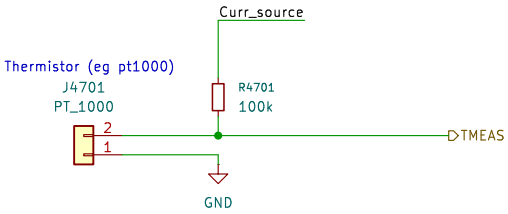
20A
TPS1685
TPS25983
LTC4226



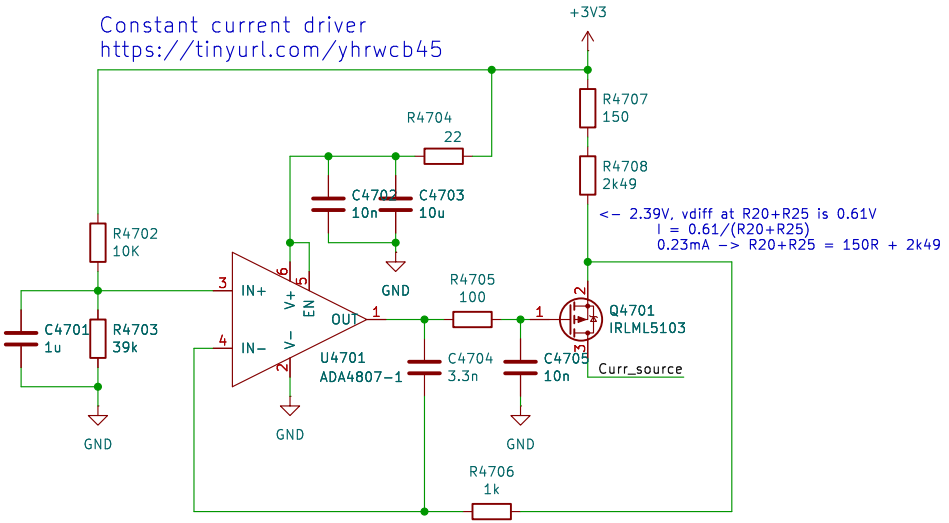
Sheet: /Solar_input_4/Switch_SOL_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 44/106



From spacetemp



Sheet: /Solar_input_4/Temp_sens_solar_cell/		
File: Temp_sens.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 49/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

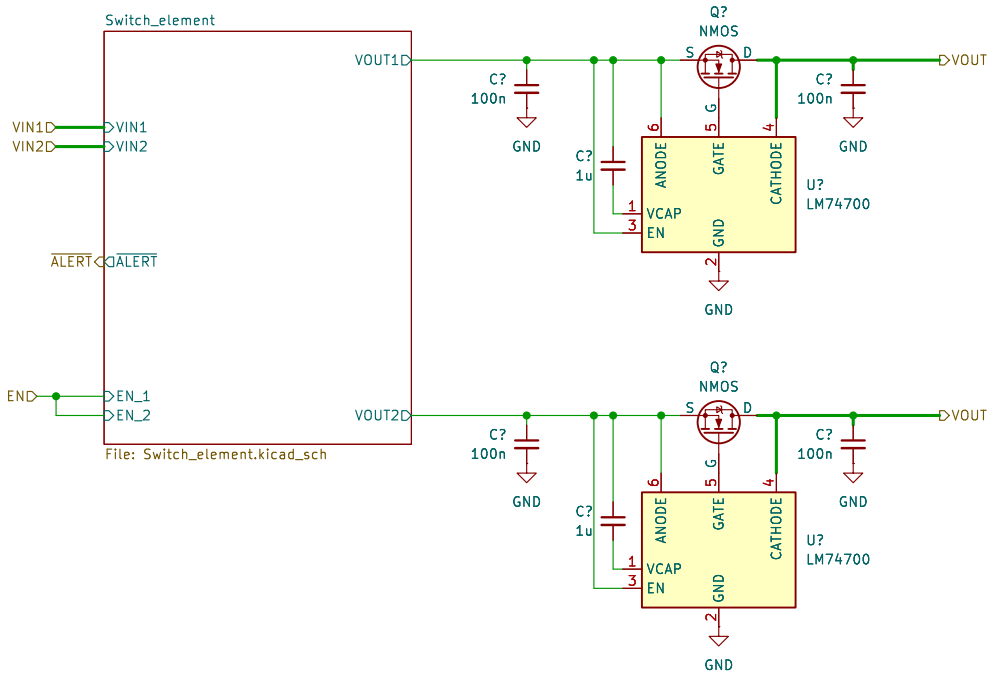
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_4/Switch_SOL_2/
File: Switch_H.kicad_sch

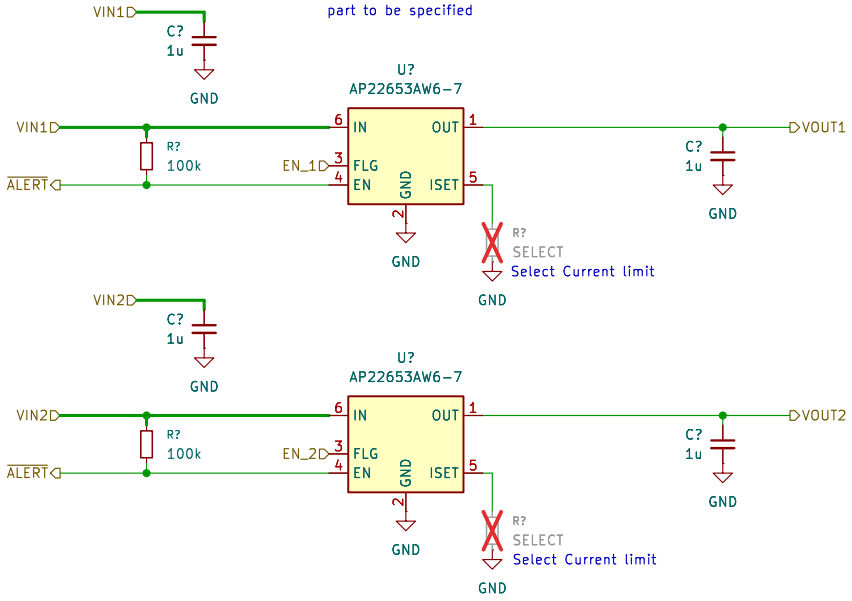
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 53/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

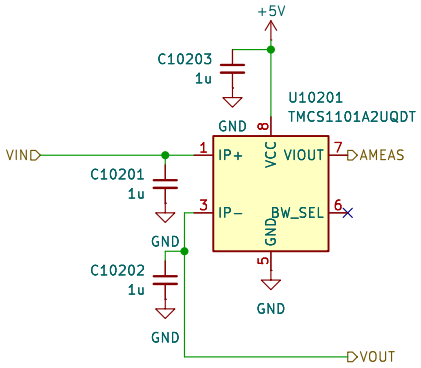
20A
TPS1685
TPS25983
LTC4226



Sheet: /Solar_input_4/Switch_SOL_2/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 104/106



Sheet: /Solar_input_4/AMEAS_1/
File: Current_Measure.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 108/106

Inputs	Outputs
Solar Cell	Ouput voltage
	Measured voltage
	Measured current
	Temperature of the Cell

Input for solar cell with MPPT tracking
reverse current protection.
Temperature measurement

DC/DC controlled using PWM from CPU
to create MPPT function

solar 4S –> voltage > VBUS

MPPT Buck DC/DC

vyhoda Nastaveni
pomoci odporu a ne
ulozeni v registur

PV
TP6001
D5801
D_Schottky
R6005
10
C6001
1u
GND
U6001
BQ24650
REGN
C6003
1u
C6005
1u
R6001
500k
VCC
HIDRV
PH
BTST
REGN
LODRV
SRP
SRN
VFB
TS
STAT1
STAT2
VREF
TERM_EN
MPPSET
Q6002
NMOS
Q6003
NMOS
C6004
1u
L6001
TBD
R6008
20m
C6006
1u
C6008
1u
D6001
D_Schottky
C6002
1u
Termistor for monitoring
should be bypassed
with EN signal from MCU
R6003
40k
TP6002
Term
V term set to 60% –>
charging is always ON
R6004
60k
TP6003
Disable
Charging
EN
CE
Q6001
NMOS
R6002
36k
MPPTSET is regulated at 1.2V
$V_{MPPSET} = 1.2\,V \times \left[1 + \frac{R3}{R4}\right]$
STAT_1
STAT_2
+5V+5V
R6006
100k
R6007
100k
TP6004
C6007
1u
R6009
500k
R6010
67k
Output battery
voltage adj
2.1V on VFB
$V_{BAT} = 2.1\,V \times \left[1 + \frac{R2}{R1}\right]$
where
- R2 is connected from VFB to the battery
- and R1 is connected from VFB to GND.

Charging current
$I_{CHARGE} = \frac{40\,mV}{R_{SR}}$
$I_{PRECHARGE} = \frac{4\,mV}{R_{SR}}$

Switch_SOL_1
VIN1
VIN2
VOUT
ALERT
EN
R6011
100k
R6012
1k

Toggles between fixed and MPPT
Default: fixed
TOGGLED
TP6005

Switch_SOL_2
FIXED_IN
R6015
100k
R6013
10
R6016
1k
R6014
100k
NMOS
Q6004

AMEAS_1
PV_IN
VIN
VOUT
PV
AMEASD
AMEAS

PV
R5805
1M
VMEAS
R5806
1M
GND

Temp_sens_solar_cell
TMEASD
TMEAS
File: Temp_sens.kicad_sch

Sheet: /Solar_input_5/
File: Solar_Cell_Input.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 62/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

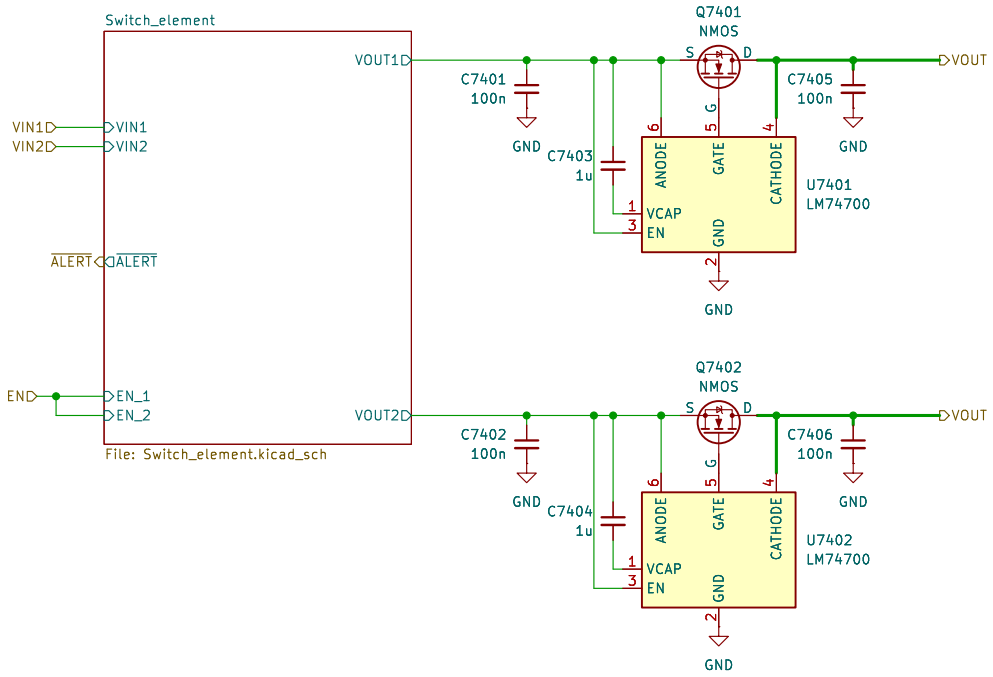
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_5/Switch_SOL_1/
File: Switch_H.kicad_sch

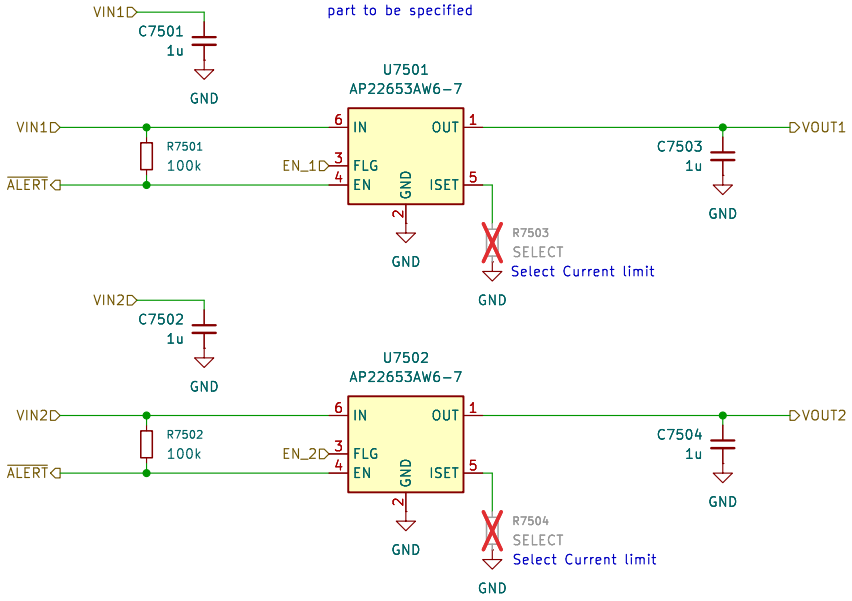
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 77/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

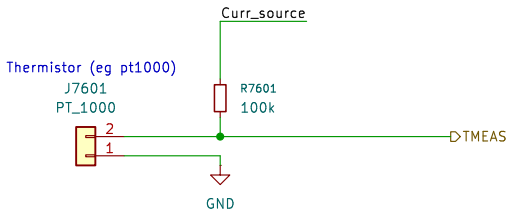
20A
TPS1685
TPS25983
LTC4226



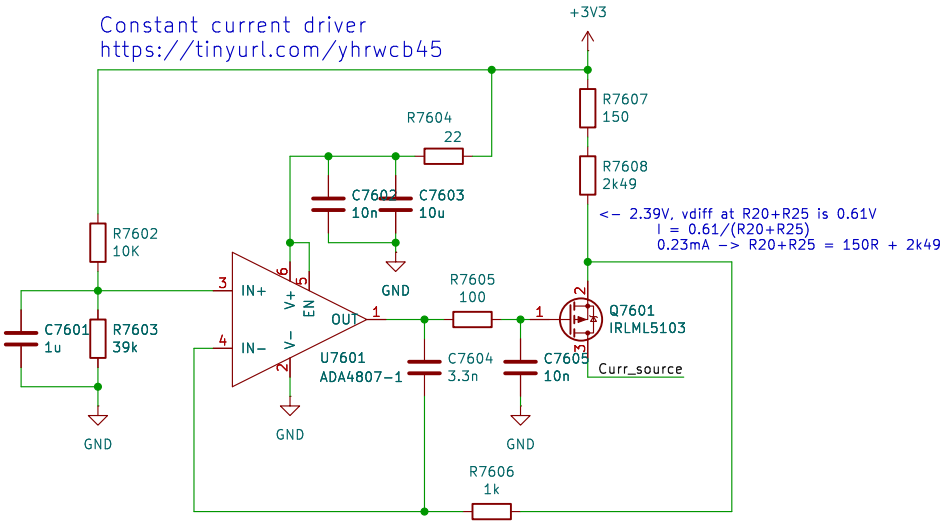
Sheet: /Solar_input_5/Switch_SOL_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 78/106



From spacetemp



Sheet: /Solar_input_5/Temp_sens_solar_cell/
File: Temp_sens.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 79/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

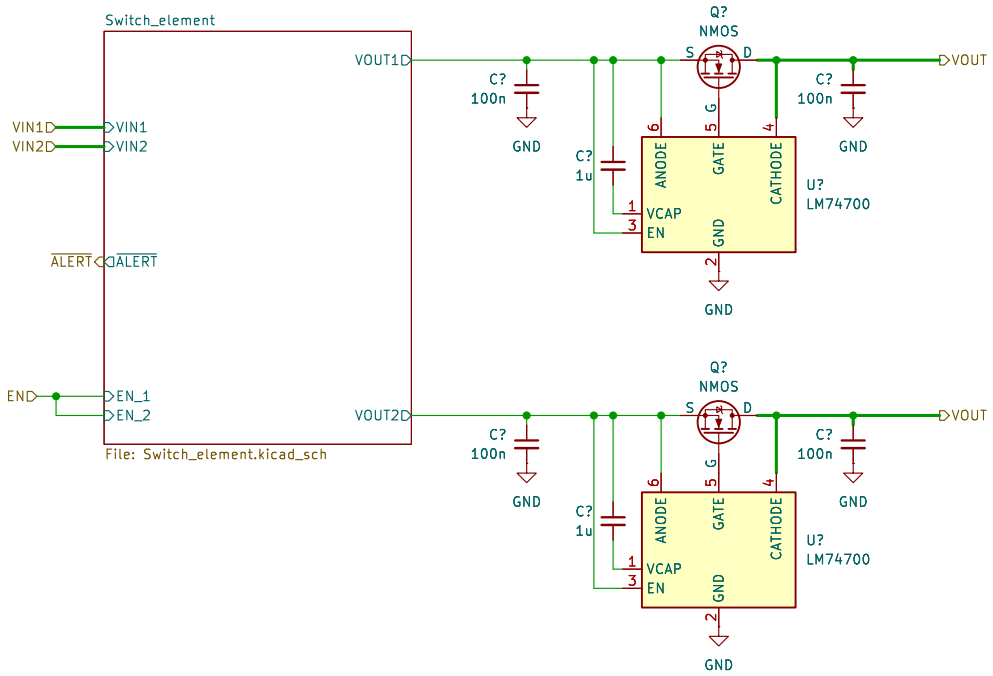
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_5/Switch_SOL_2/
File: Switch_H.kicad_sch

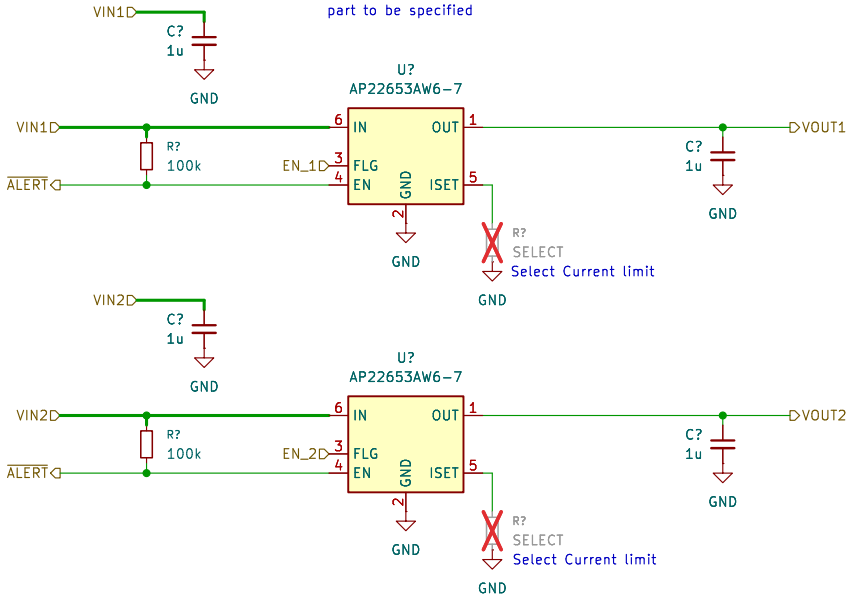
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 80/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

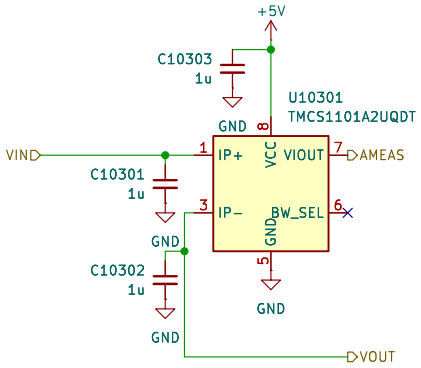
20A
TPS1685
TPS25983
LTC4226



Sheet: /Solar_input_5/Switch_SOL_2/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 105/106



Sheet: /Solar_input_5/AMEAS_1/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 109/106

PV PCB

VBUS
J6103
VBUS
GND

PV_1
J6101
PV
GND

PV_2
J6104
PV
GND

PV_3
J6106
PV
GND

PV_4
J6102
PV
GND

PV_5
J6105
PV
GND

PV_6
J6107
PV
GND

OUTPUT PCB

Channel_1
J6108
Chan
GND

Channel_2
J6109
Chan
GND

Channel_3
J6110
Chan
GND

Channel_4
J6111
Chan
GND

Channel_5
J6112
Chan
GND

Channel_6
J6113
Chan
GND

Channel_7
J6123
Chan
GND

Channel_8
J6124
Chan
GND

Channel_9
J6120
Chan_BUS
GND

Channel_10
J6121
Chan_BUS
GND

VBUS
J6122
VBUS
GND

BATTERY

J6125
BATT_PACK
BATTERY_1
BATTERY_1
TMEAS_BATT_1
HEAT_BATT_1
SDA
SCL
GND

J6126
BATT_PACK
BATTERY_2
BATTERY_2
TMEAS_BATT_2
HEAT_BATT_2
SDA
SCL
GND

H6101
PC104
H6103
PC104
H6105
PC104
CAN_L
CAN_H
SDA
SCL
RS422_Rx_P
RS422_Rx_N
RS422_Tx_P
RS422_Tx_N

H6102
PC104
H6104
PC104
H6106
PC104
+5V
+3V3
GND
TxD
RxD
Battery

J6129
VBUS
PV PCB
GND

J6130
VBUS
OUTPUT PCB
GND

J6131
Battery
BATT_PACK_1
TMEAS_BATT_1
HEAT_BATT_1
SDA
SCL
GND

J6132
Battery
BATT_PACK_2
TMEAS_BATT_2
HEAT_BATT_2
SDA
SCL
GND

J6114
HEADER_PV
J6115
HEADER_PV
SOL_TGGL_1
SOL_TGGL_2
SOL_TGGL_3
MPPT_EN
SOL_STAT_1
SOL_STAT_2
GND

J6117
HEADER_CHAN
J6116
HEADER_CHAN
Ch_EN_11
Ch_EN_21
Ch_EN_31
Ch_EN_41
Ch_EN_51
Ch_EN_61
Ch_EN_7x
Ch_EN_91
Ch_EN_101
GND

J6119
HEADER_CHAN
J6118
HEADER_CHAN
Ch_EN_12
Ch_EN_22
Ch_EN_32
Ch_EN_42
Ch_EN_52
Ch_EN_62
Ch_EN_8x
Ch_EN_92
Ch_EN_102
GND

{Channels}
Channel_1
Channel_2
Channel_3
Channel_4
Channel_5
Channel_6
Channel_7
Channel_8
Channel_9
Channel_10

{Enables}
Ch_EN_11
Ch_EN_12
Ch_EN_21
Ch_EN_22
Ch_EN_31
Ch_EN_32
Ch_EN_41
Ch_EN_42
Ch_EN_51
Ch_EN_52
Ch_EN_61
Ch_EN_62
Ch_EN_7x
Ch_EN_8x
Ch_EN_91
Ch_EN_92
Ch_EN_101
Ch_EN_102

on PCB make it so that resistors can be used to switch TR and RX

R_TX_6101
0
TX
TxD

R_RX_6101
0
RX
RxD

MOSI
MISO
SCK
CS_1
J6127
SPI

TxD
RxD
J6128
UART

Sheet: /Interface/
File: Interface.kicad_sch

Title:

Size: A3
Date:
Rev:
KiCad E.D.A. 9.0.4
Id: 63/106

Inputs	Outputs
Solar Cell	Ouput voltage
	Measured voltage
	Measured current
	Temperature of the Cell

Input for solar cell with MPPT tracking
reverse current protection.
Temperature measurement

DC/DC controlled using PWM from CPU
to create MPPT function

solar 4S –> voltage > VBUS

MPPT Buck DC/DC

vyhoda Nastaveni
pomoci odporu a ne
ulozeni v registur

Charging current

$I_{CHARGE} = \frac{40\ mV}{R_{SR}}$

$I_{PRECHARGE} = \frac{4\ mV}{R_{SR}}$

PV, TP7901, D7301 D_Schottky, R7905 10, C7905 1u, GND

U7901 BQ24650

R7901 500k, C7901 1u, C7903 1u, REGN

VCC, HIDRV, PH, BTST, REGN, LODRV, VREF, TERM_EN, MPPSET, SRP, SRN, VFB, TS, STAT1, STAT2, GND

Q7902 NMOS, Q7903 NMOS, C7904 1u, D7901 D_Schottky, C7902 1u

L7901 TBD, R7908 20m, C7906 1u, C7908 1u

Termistor for monitoring
should be bypassed
with EN signal from MCU

R7903 40k, TP7902, Term, R7904 60k

V term set to 60% –>
charging is always ON

TP7903

Disable
Charging

Q7901 NMOS, R7902 36k

MPPTSET is regulated at 1.2V

$V_{MPPSET} = 1.2\ V \times \left[1 + \frac{R3}{R4}\right]$

+5V+5V, R7906 100k, R7907 100k, STAT_1, STAT_2

TP7904, C7907 1u, R7909 500k, R7910 67k

$V_{BAT} = 2.1\ V \times \left[1 + \frac{R2}{R1}\right]$

where
- R2 is connected from VFB to the battery
- and R1 is connected from VFB to GND.

Output battery
voltage adj
2.1V on VFB

Switch_SOL_1, VIN1, VIN2, VOUT, ALERT, EN

R7911 100k, R7912 1k

Toggles between fixed and MPPT
Default: fixed

TOGGLED, TP7905

Switch_SOL_2, FIXED_IN

R7915 100k, R7913 10, R7916 1k, R7914 100k

NMOS Q7904

AMEAS_1, PV_IN, VIN, VOUT, PV, AMEASD, AMEAS

PV, R7301 1M, VMEAS, R7302 1M, GND

Temp_sens_solar_cell, TMEASD, TMEAS

File: Temp_sens.kicad_sch

Sheet: /Solar_input_6/
File: Solar_Cell_Input.kicad_sch

Title:

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 82/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

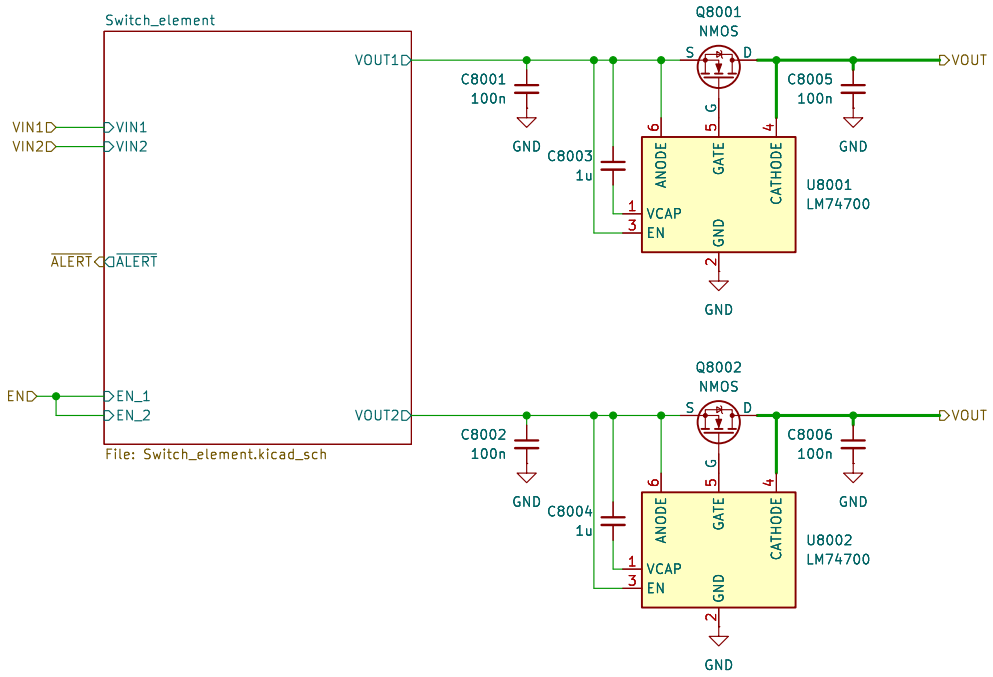
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_6/Switch_SOL_1/
File: Switch_H.kicad_sch

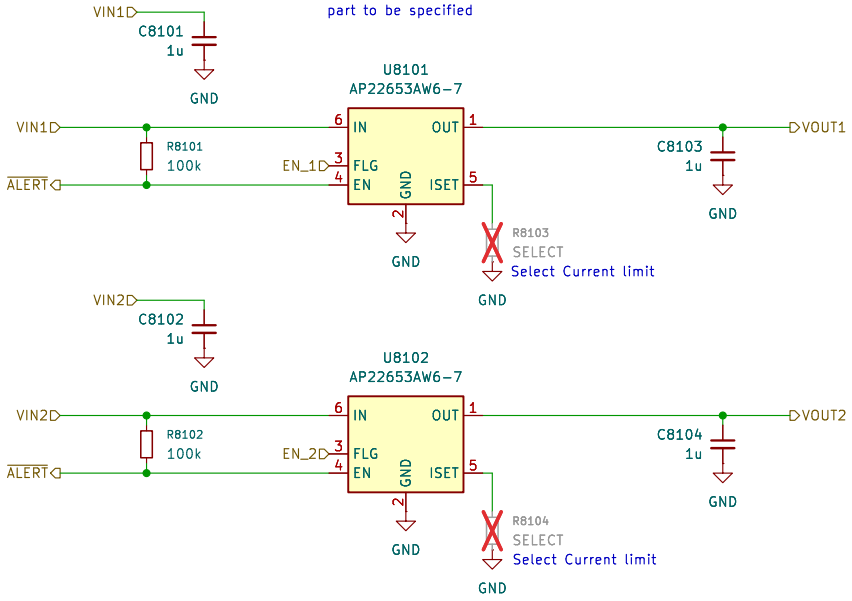
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 83/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

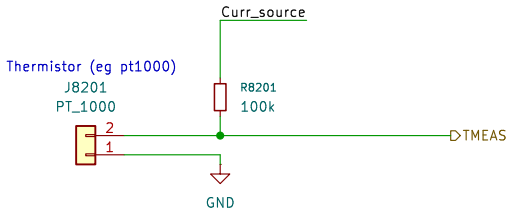
20A
TPS1685
TPS25983
LTC4226



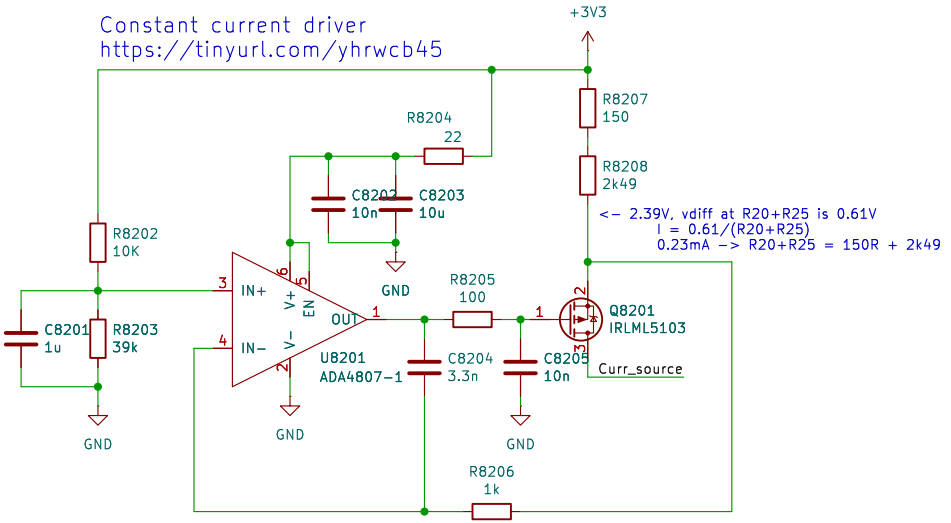
Sheet: /Solar_input_6/Switch_SOL_1/Switch_element/
File: Switch_element.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 84/106



From spacetemp



Sheet: /Solar_input_6/Temp_sens_solar_cell/
File: Temp_sens.kicad_sch

Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 85/106

Inputs	Outputs
Input voltage	Output voltage
Input from CPU	

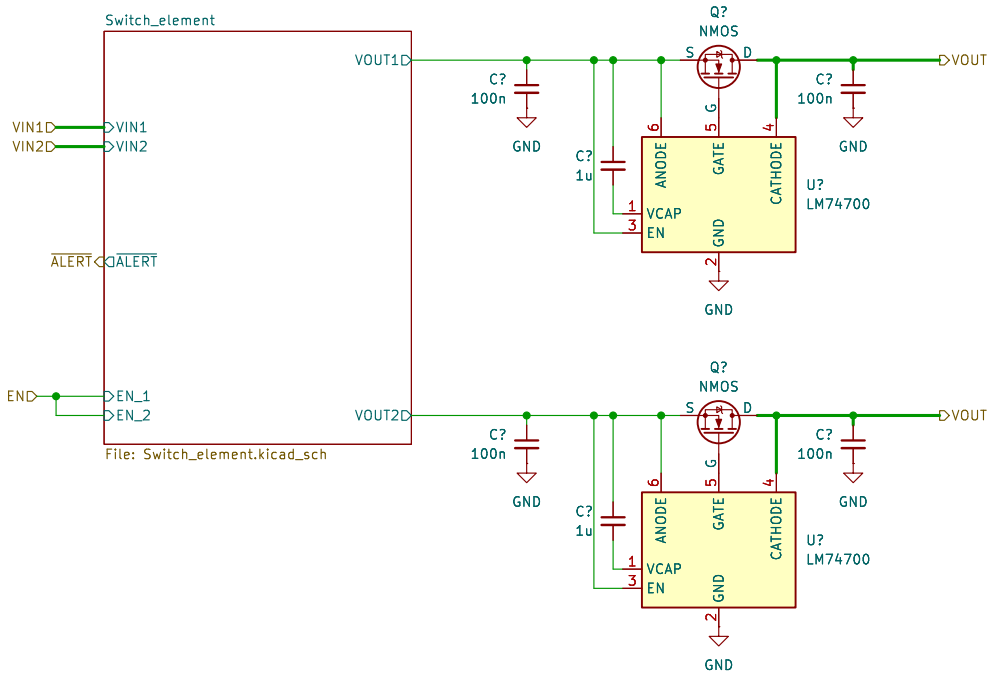
dedikovany ideal diode IC

Generic Switch

soft current limit – software
hard current limit – Resistor

kalibrace ADC mereni proudu

hot/cold redundance
hot – 1 enable automatic
cold – 2 enables manual



Sheet: /Solar_input_6/Switch_SOL_2/
File: Switch_H.kicad_sch

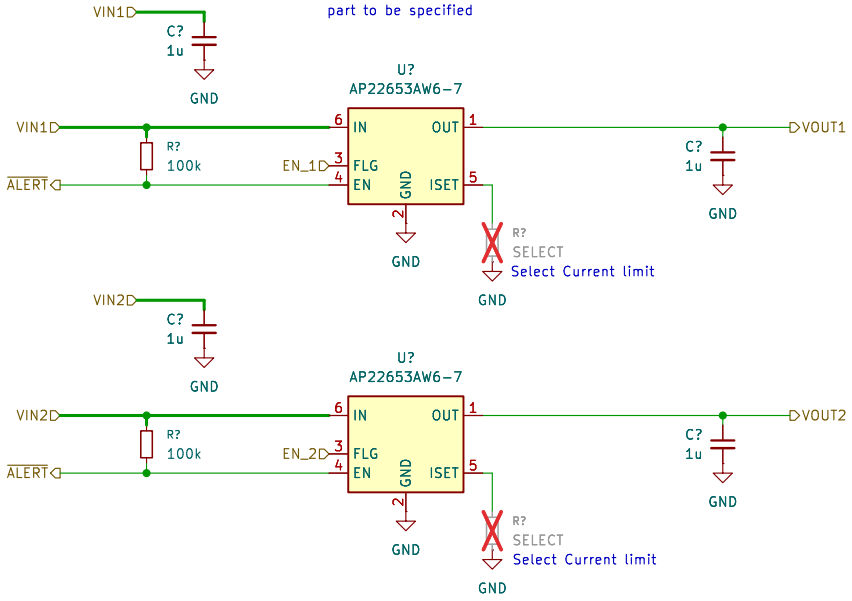
Title:

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 86/106

Candidates

6A
TPS281C30ERGWR
TPS25910RSAR
TPS1H200A-Q1 – too much Ron

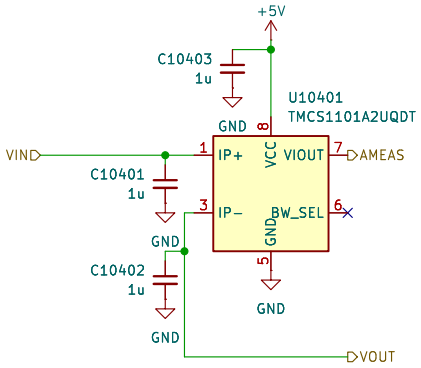
20A
TPS1685
TPS25983
LTC4226



Sheet: /Solar_input_6/Switch_SOL_2/Switch_element/
File: Switch_element.kicad_sch

Title:

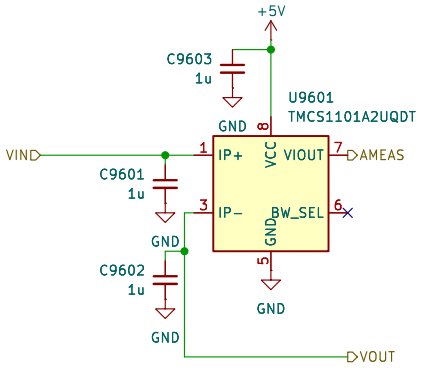
Size: A4 | Date: | **Rev:**
KiCad E.D.A. 9.0.4 | Id: 106/106



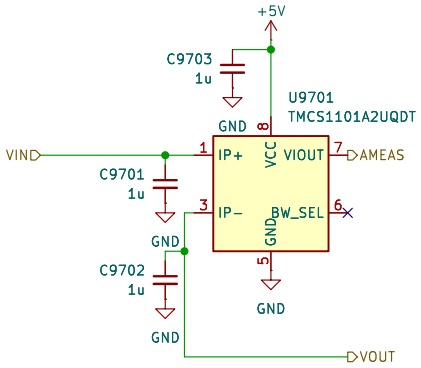
Sheet: /Solar_input_6/AMEAS_1/
File: Current_Measure.kicad_sch

Title:

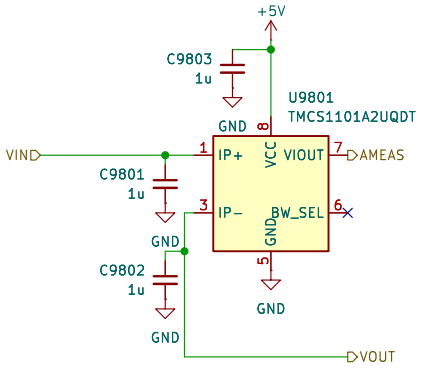
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 110/106



Sheet: /AMEAS_BUS/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 102/106



Sheet: /AMEAS_BATT_1/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 103/106



Sheet: /AMEAS__BATT_2/		
File: Current_Measure.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.4		Id: 104/106

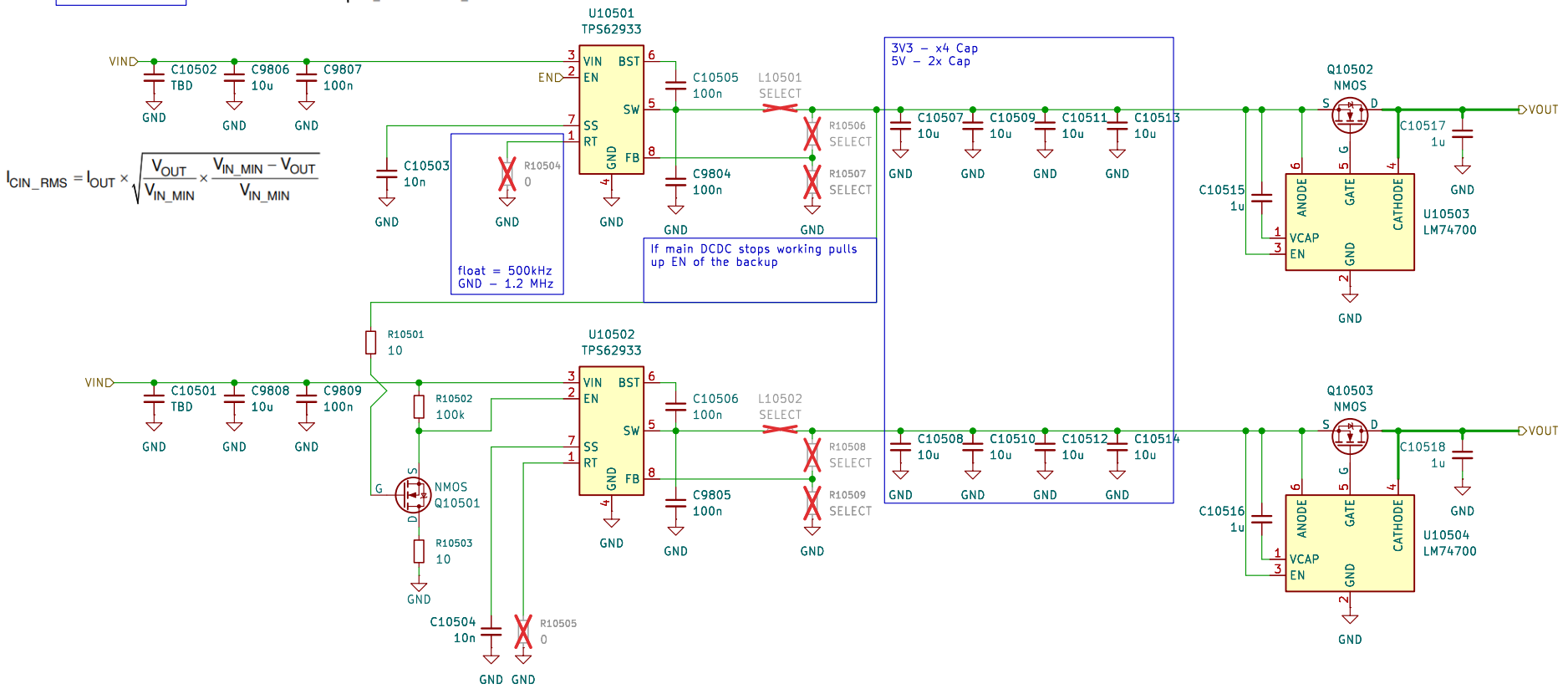
Inputs	Outputs
BUS Voltage	5V

2A

$$I_{CIN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN\_MIN}} \times \frac{V_{IN\_MIN} - V_{OUT}}{V_{IN\_MIN}}}$$

Use Rxx03 and Rxx00 to select ouput voltage

Output voltage
5V
10000*(5V−0,8)/0,8 => Rxx03,Rxx00 = 52500



Sheet: /5V_DCDC_1/
File: DCDC_ADJUCTABLE.kicad_sch

Title:

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.4		Id: 111/106